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(54) **METHOD FOR CONTROLLING VIRTUAL REALITY DEVICE, AND VIRTUAL REALITY DEVICE USING SAME**

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(57) **ABSTRACT**

Provided are a method of controlling a virtual reality device, and the virtual reality device, the method including setting a first area and a second area different from the first area in a space in which content is to be viewed is by using the virtual reality device, based on space information obtained by scanning the space in which the content is to be viewed and content information about the content; sensing the first area and the second area by using at least one image sensor while the content is being reproduced; tracking an object located in the first area or the second area, based on a result of the sensing; and controlling a display of a screen of the virtual reality device, based on a result of the tracking.

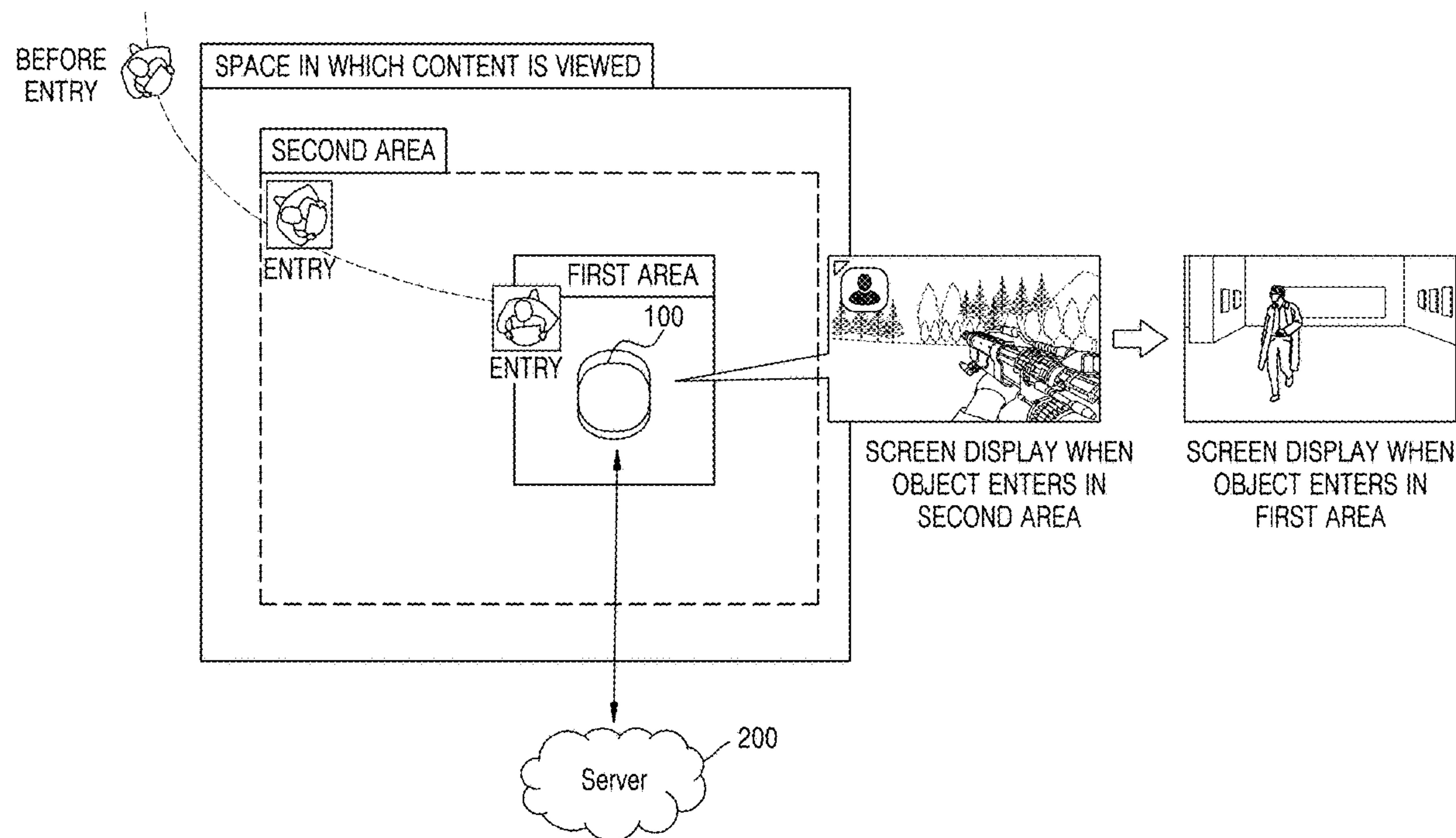


FIG. 1

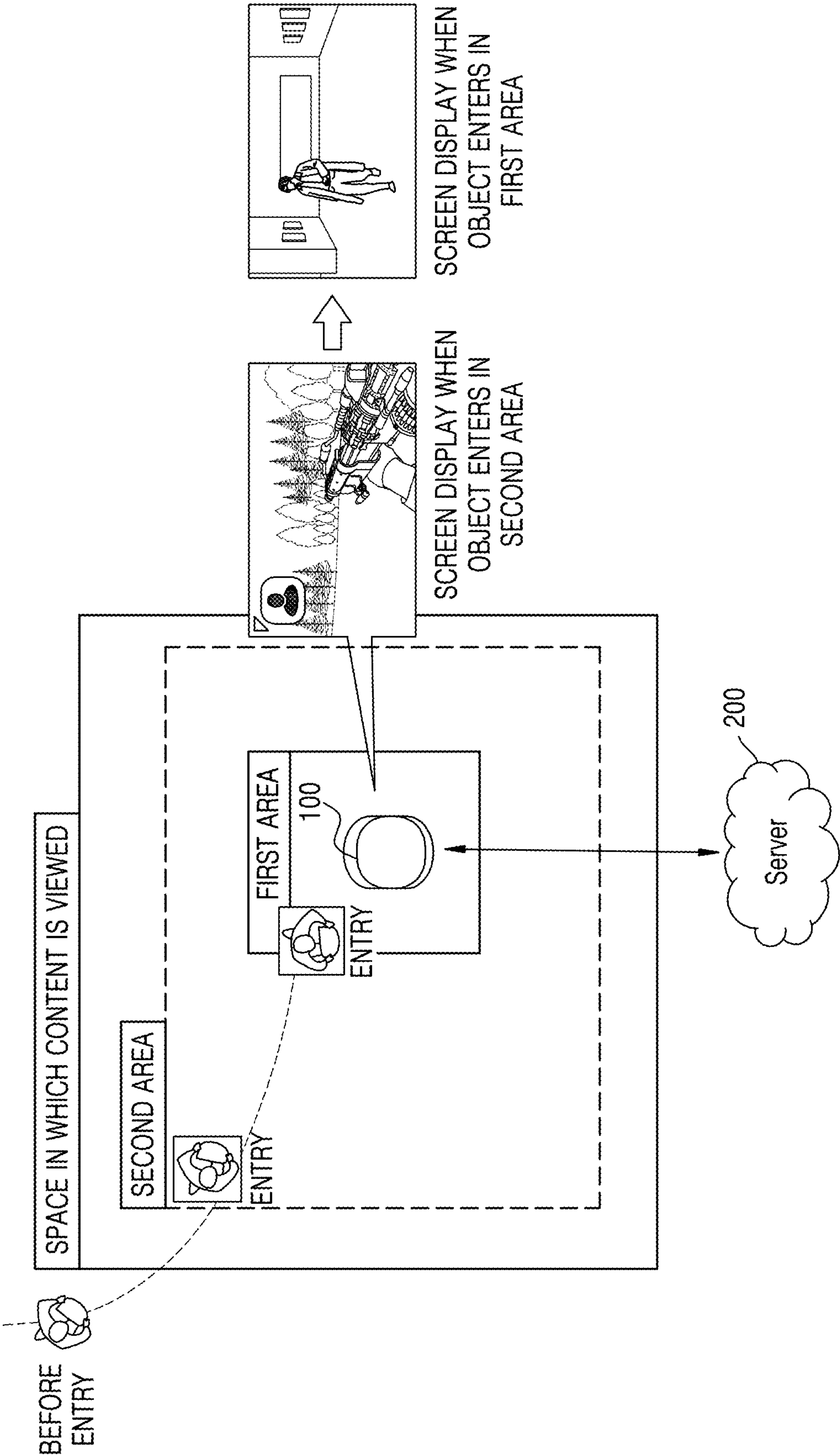


FIG. 2

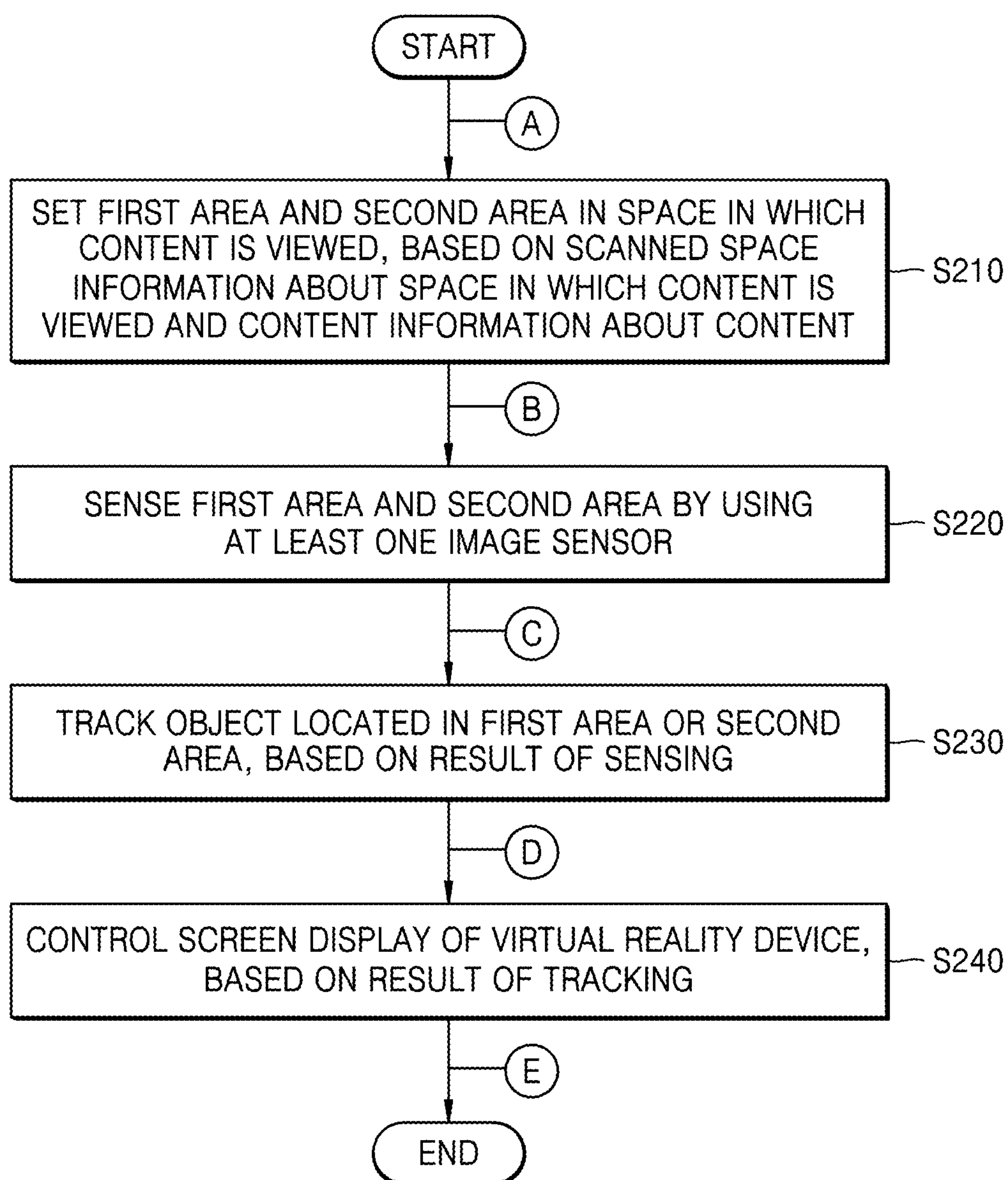


FIG. 3

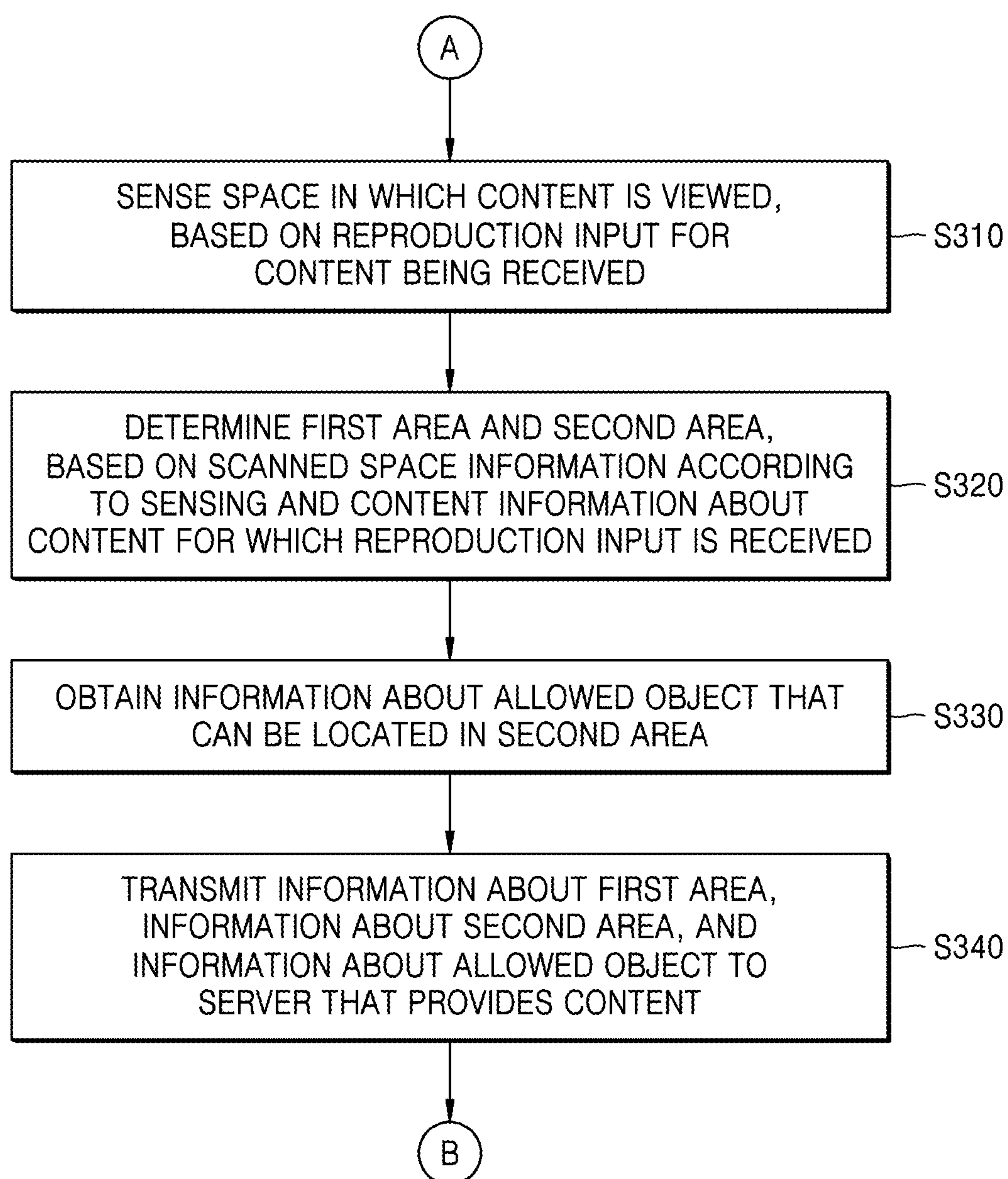


FIG. 4

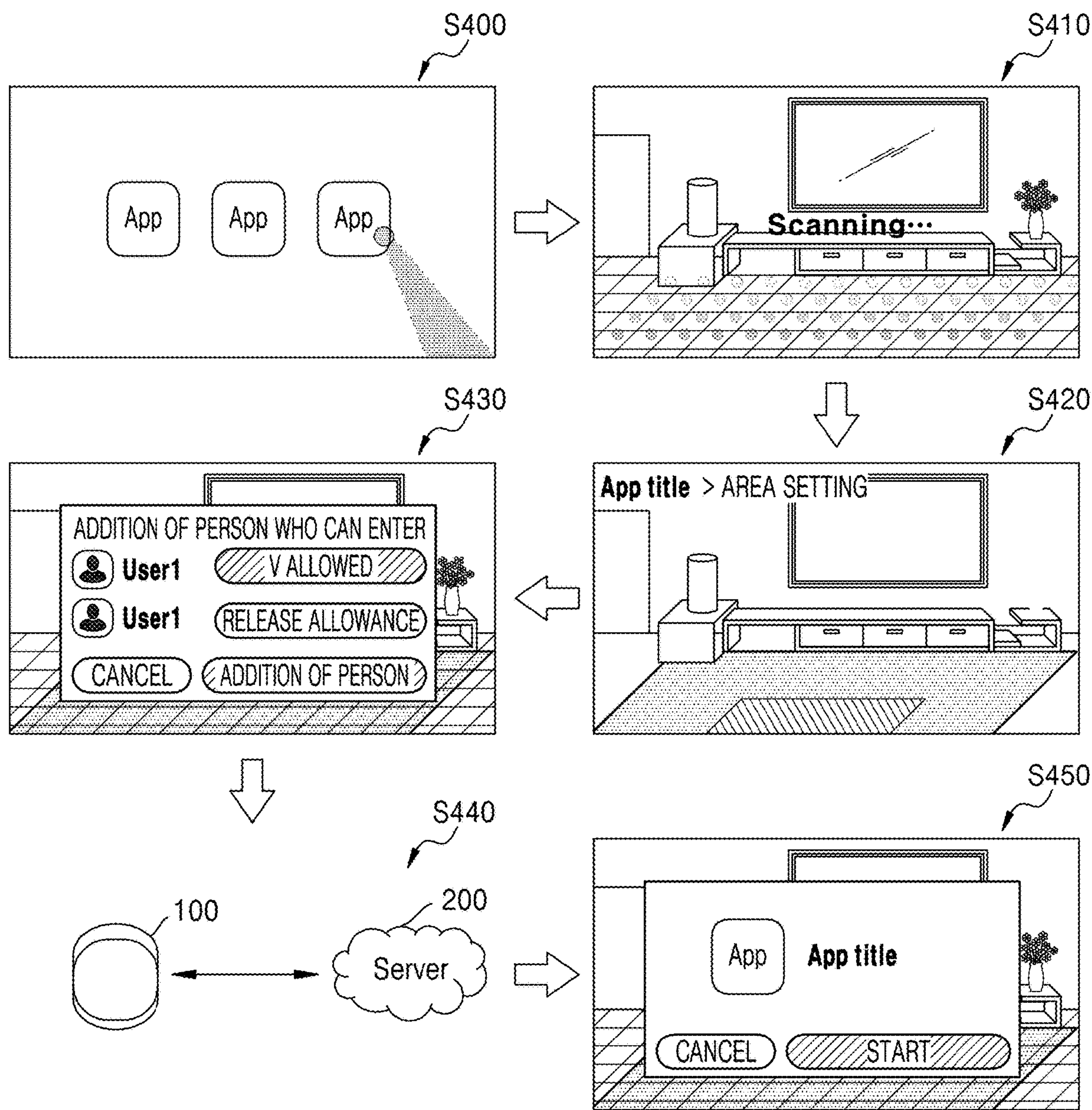


FIG. 5

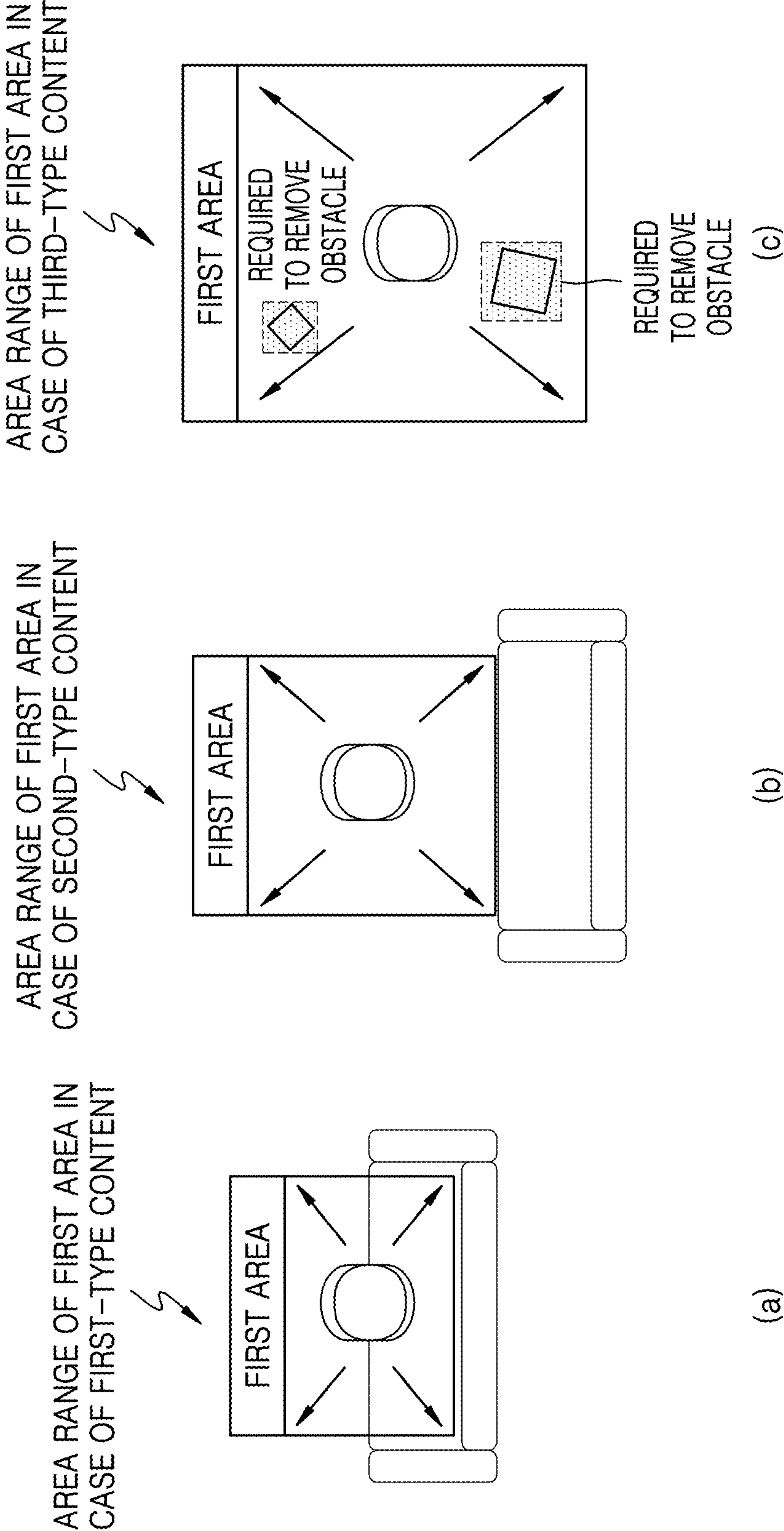


FIG. 6

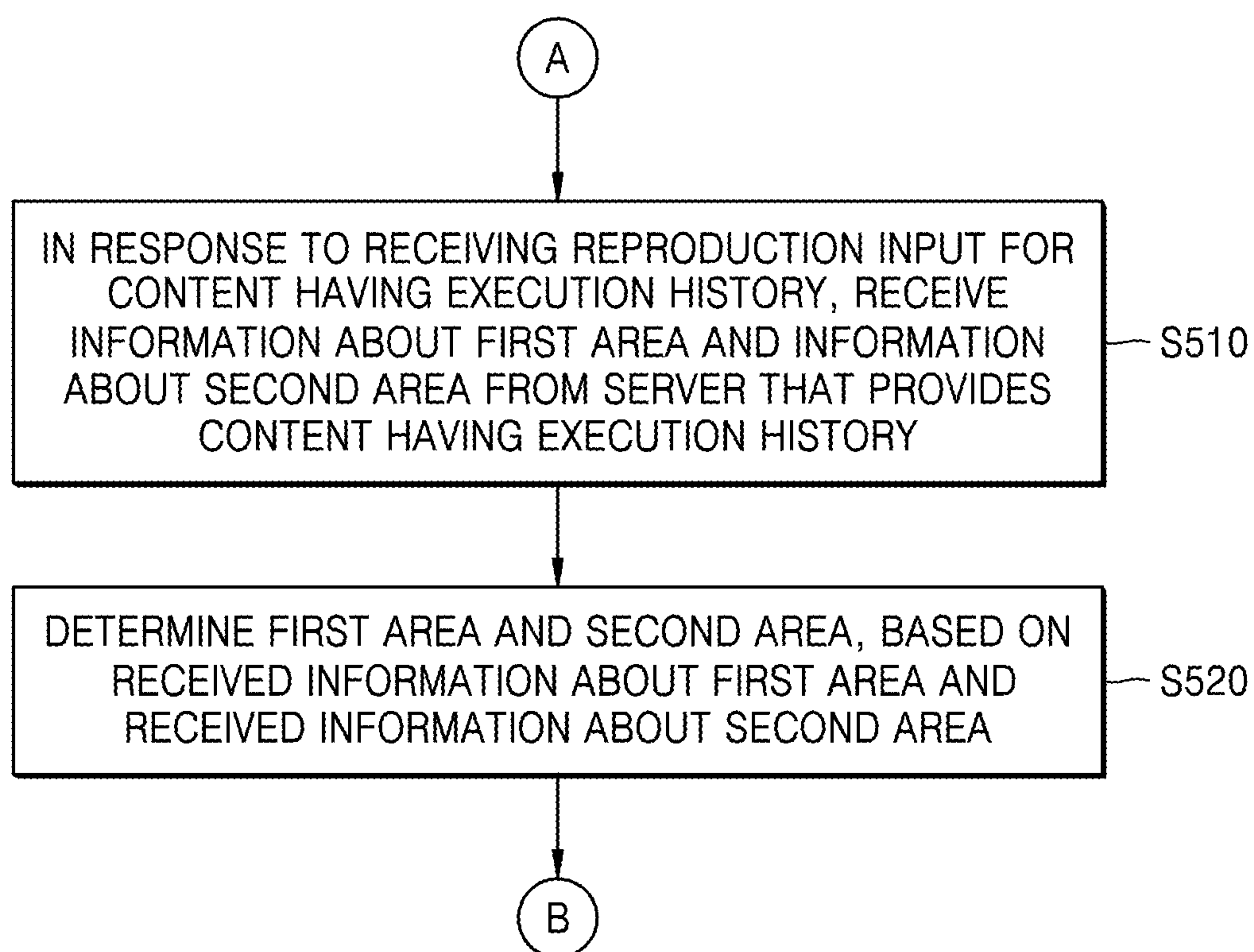


FIG. 7

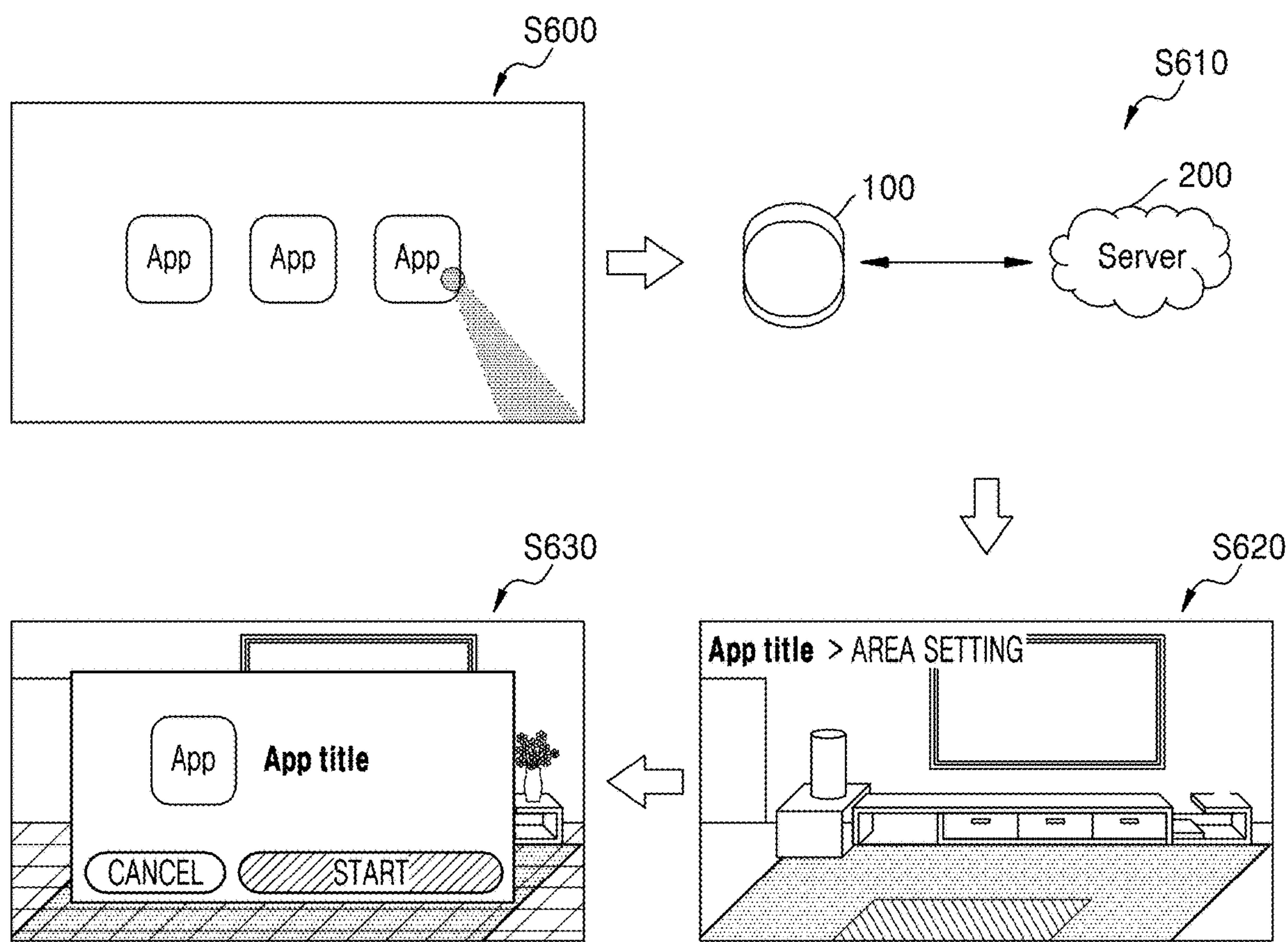


FIG. 8

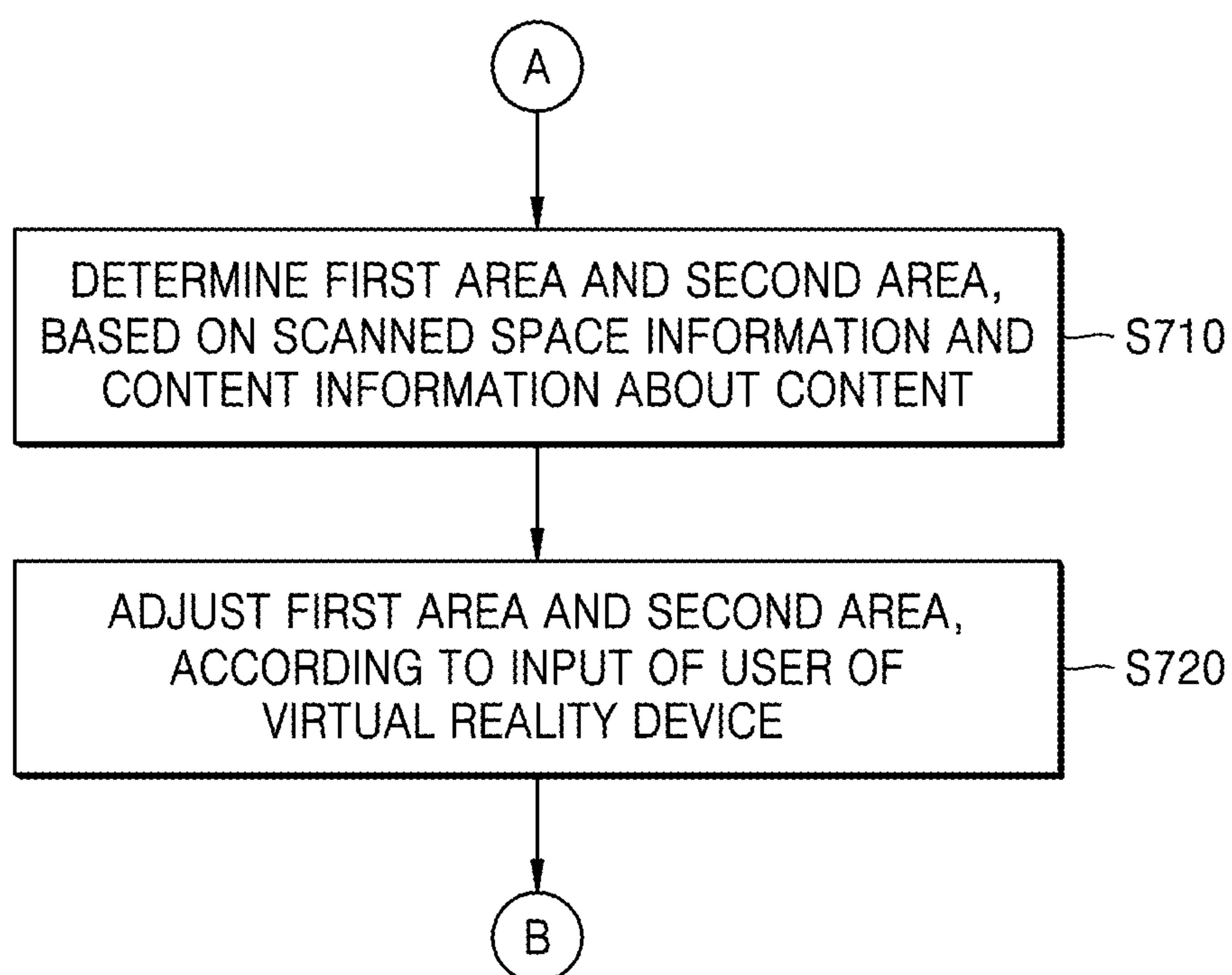


FIG. 9

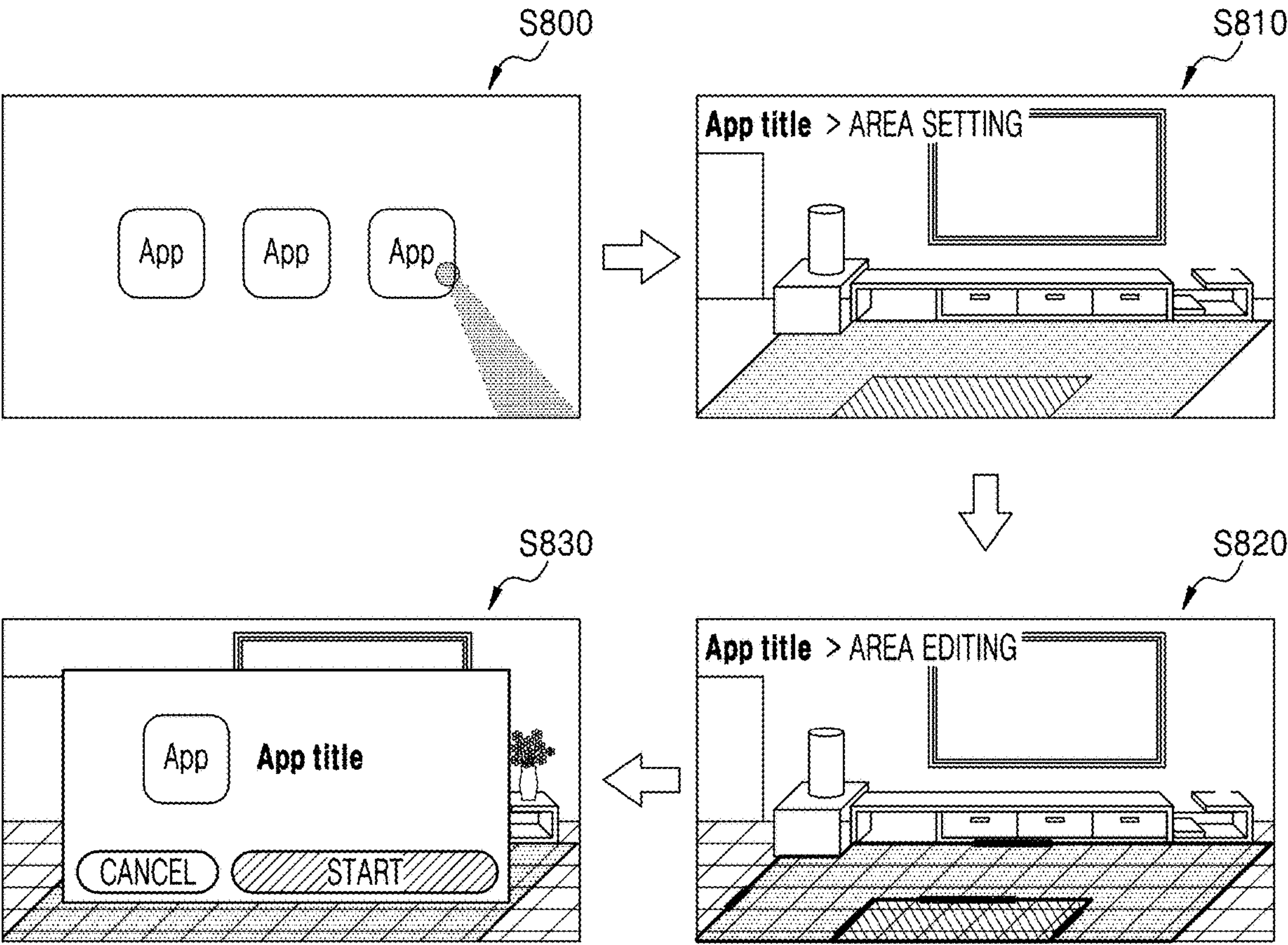


FIG. 10

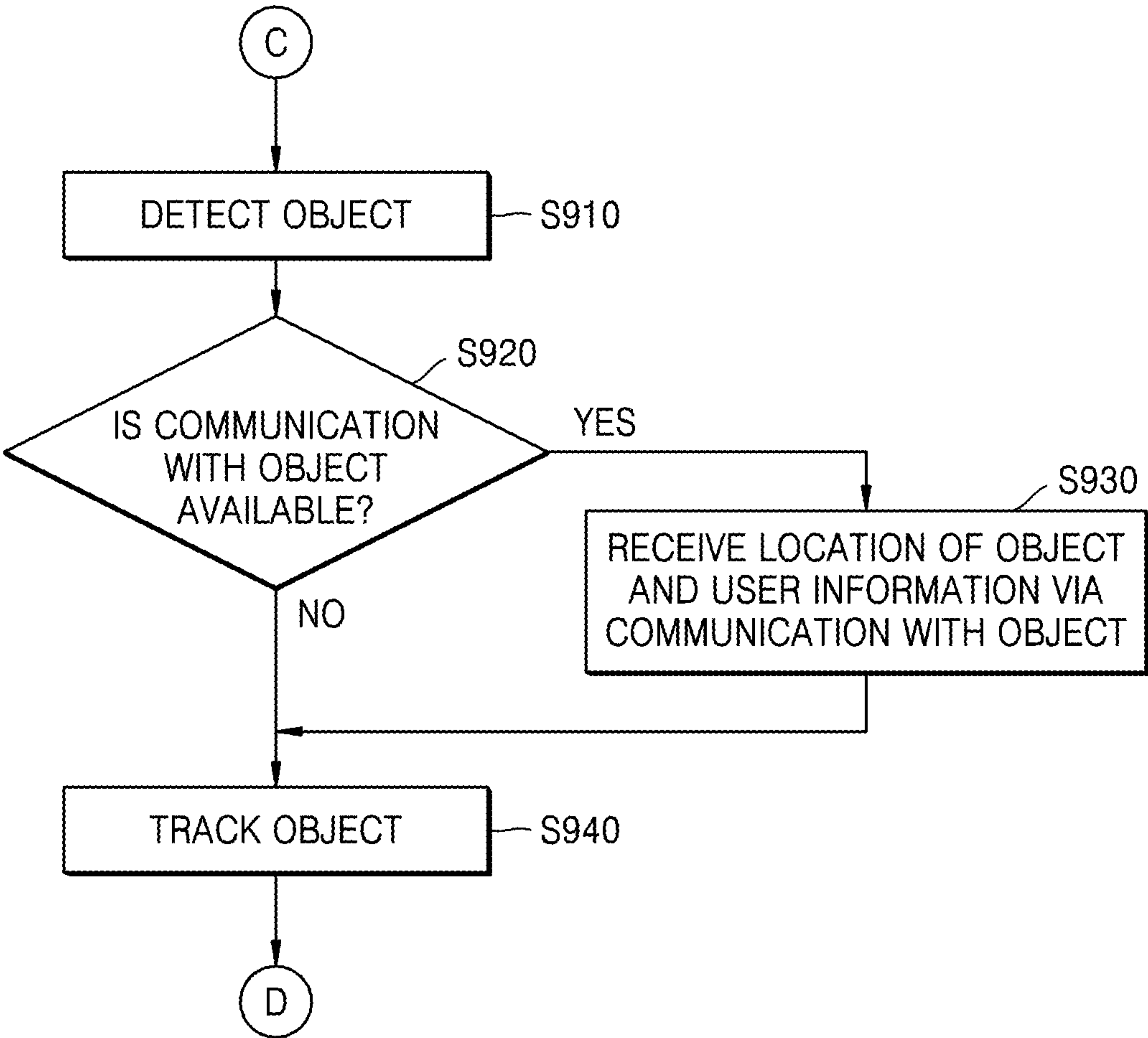


FIG. 11

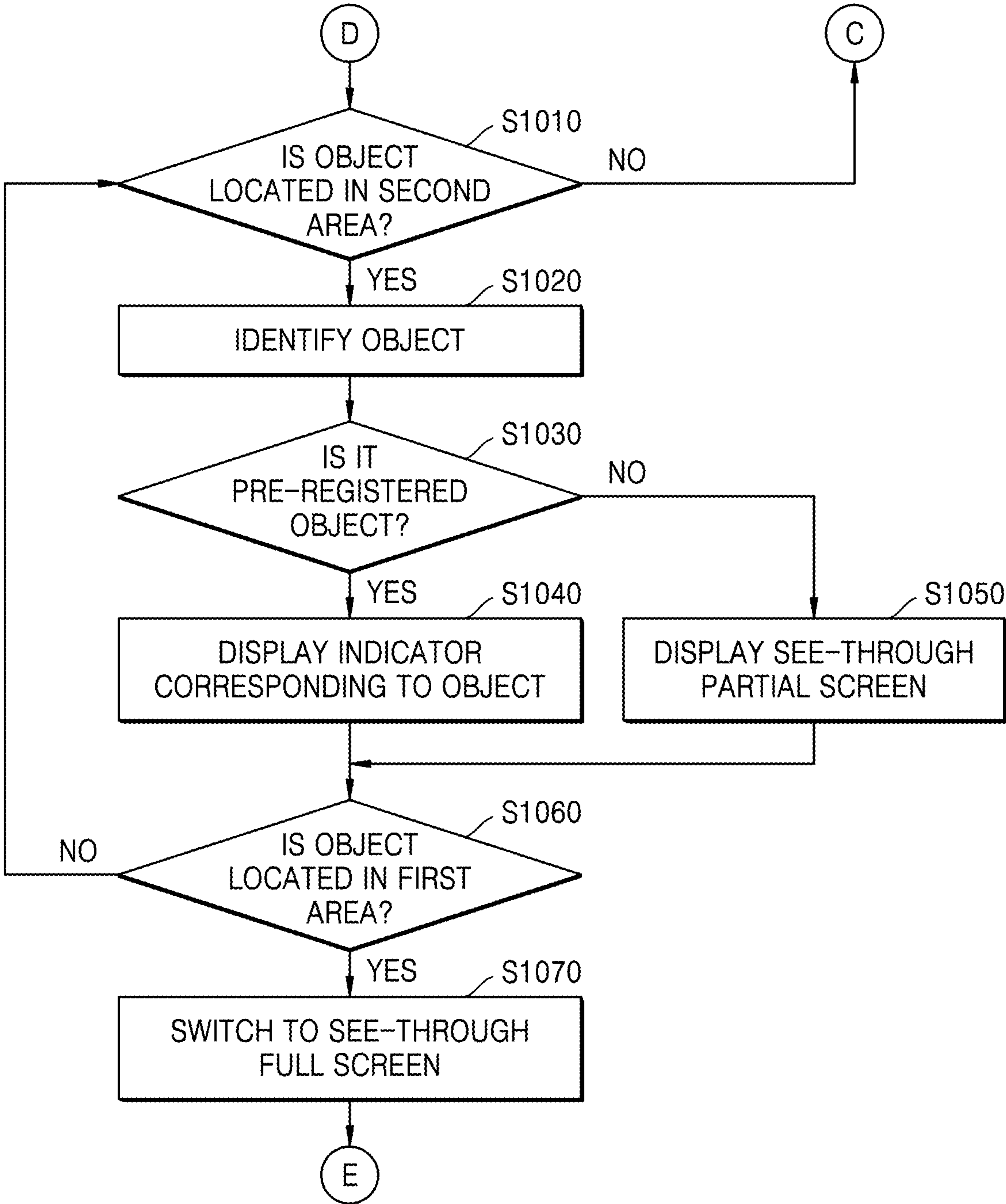


FIG. 12

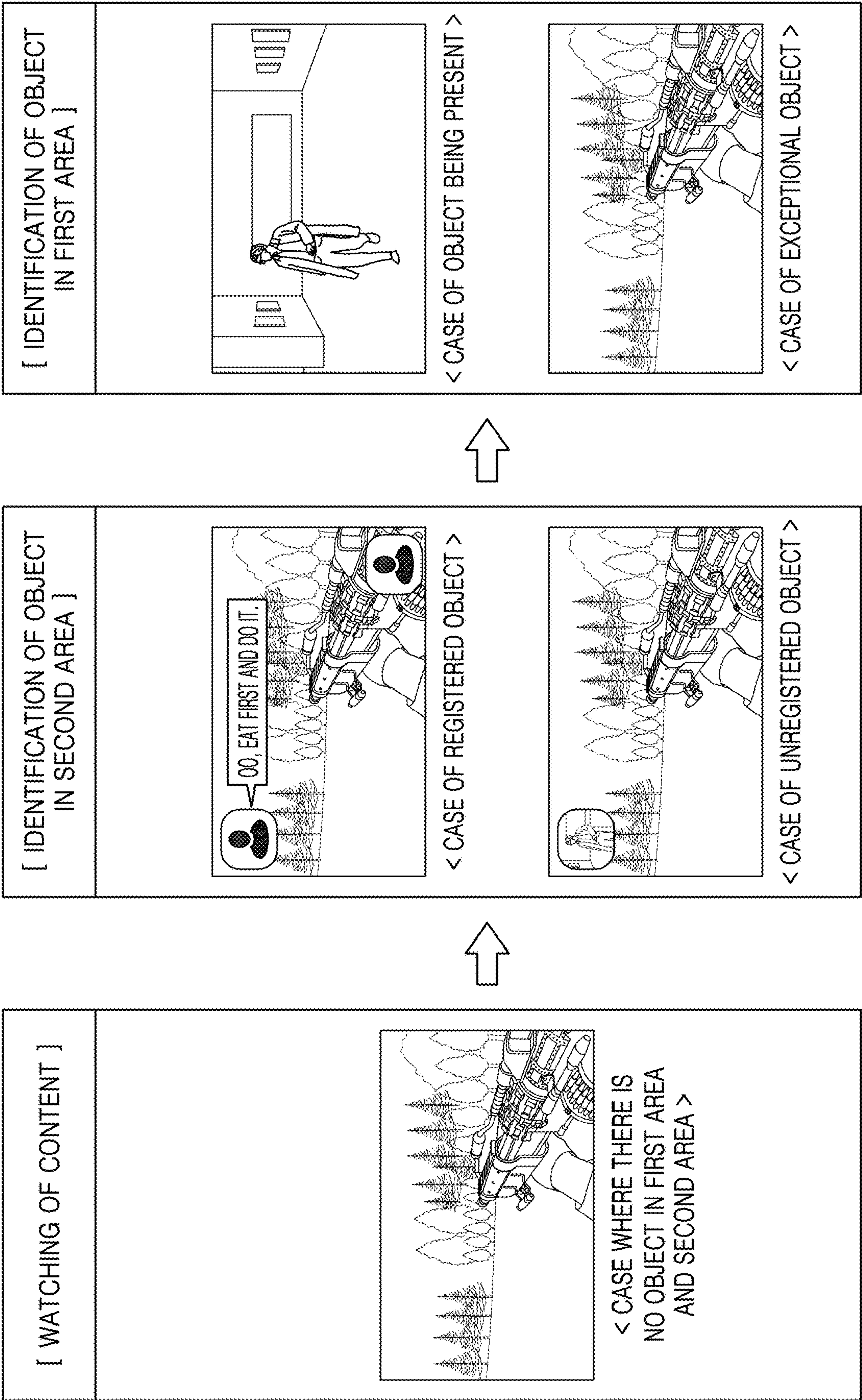


FIG. 13

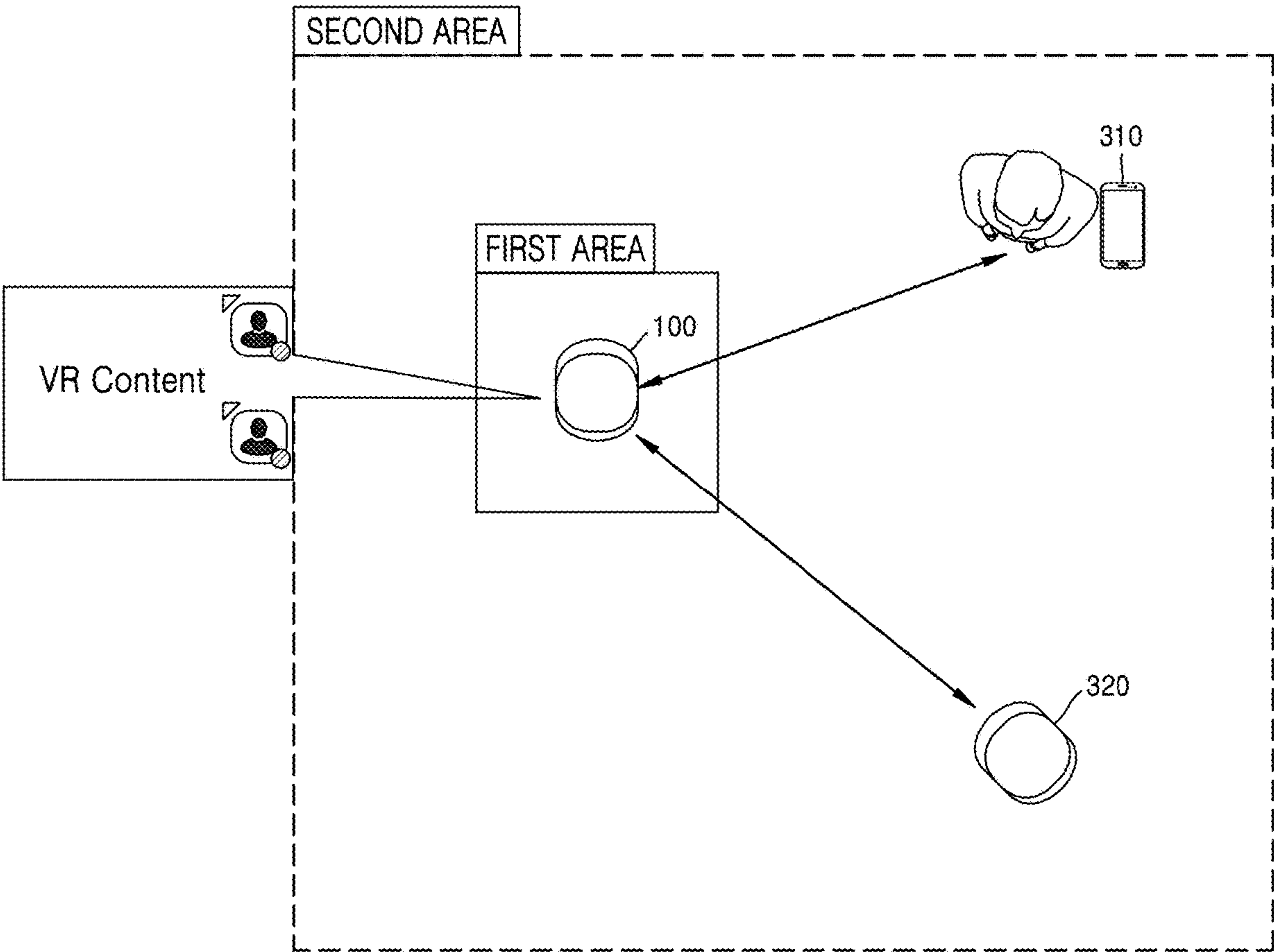


FIG. 14

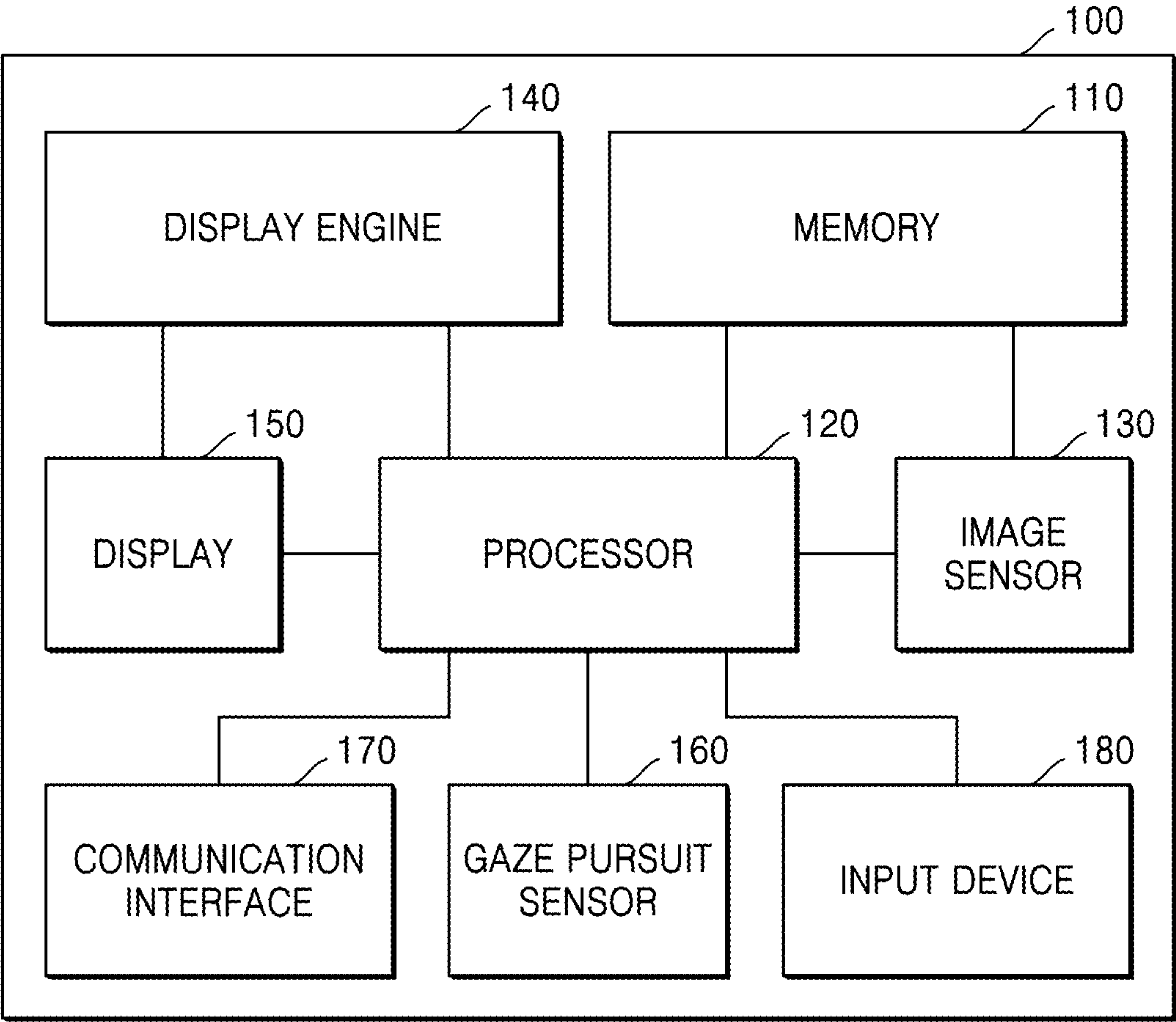
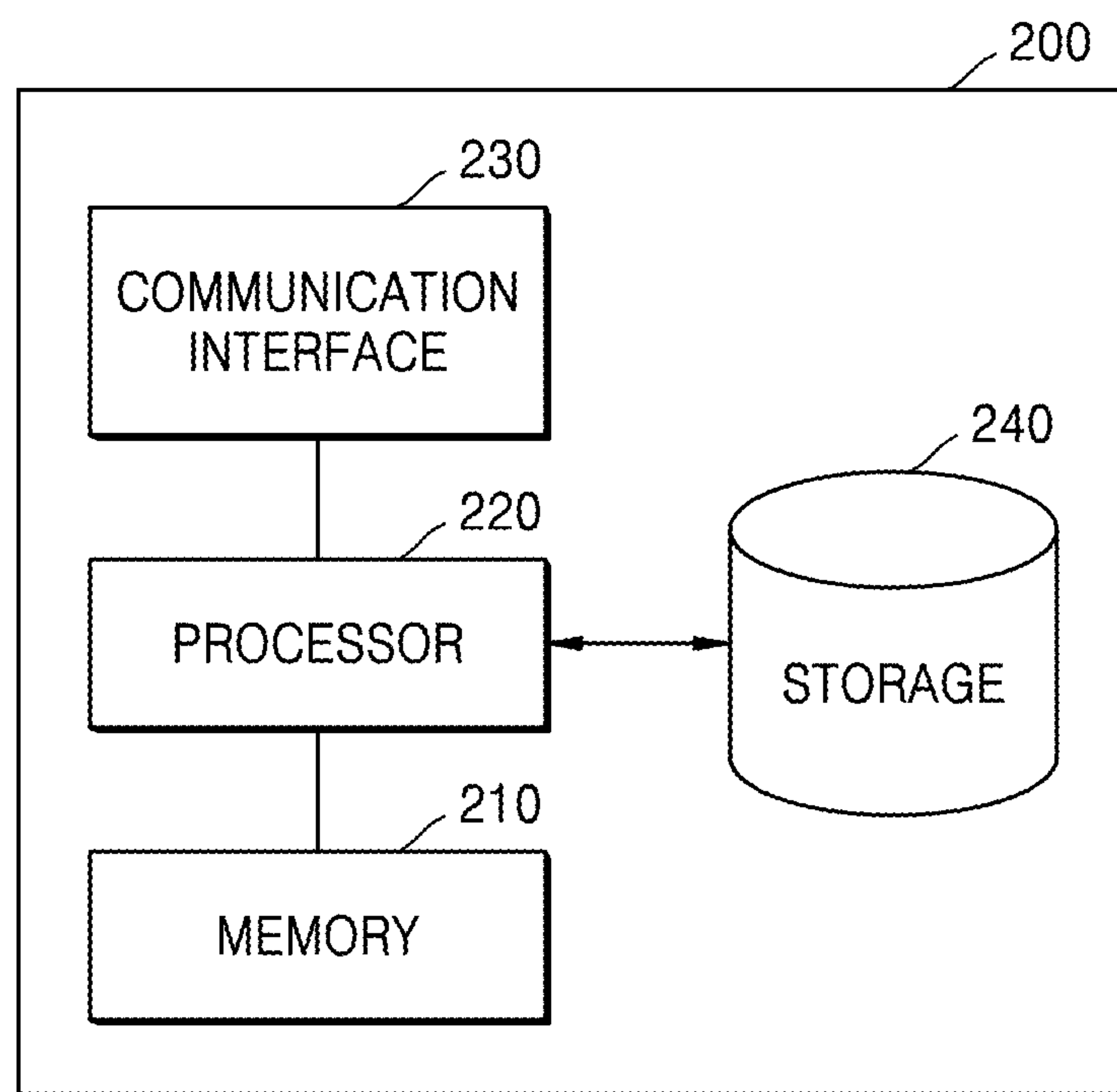


FIG. 15



METHOD FOR CONTROLLING VIRTUAL REALITY DEVICE, AND VIRTUAL REALITY DEVICE USING SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation application of International Application No. PCT/KR2023/010022, filed on Jul. 13, 2023, which claims priority from Korean Patent Application No. 10-2022-0107162, filed on Aug. 25, 2022, and Korean Patent Application No. 10-2022-0127172, filed on Oct. 5, 2022 in the Korean Intellectual Property Office, the disclosures of which are herein incorporated by reference herein in their entireties.

BACKGROUND

1. Field

[0002] One or more example embodiments of the disclosure provide a method of controlling a virtual reality device, and the virtual reality device using the same.

2. Description of Related Art

[0003] Virtual reality refers to showing a virtual image that may be experienced like reality in a virtual space. A virtual reality device indicates a device capable of expressing 'virtual reality', and may include, for example, a head-mounted display device, a virtual reality helmet, or a goggles-type display device completely covering a user's field of view.

SUMMARY

[0004] According to an aspect of an example embodiment of the disclosure, provided is a method of controlling a virtual reality device including: based on space information obtained by scanning a space in which content is to be viewed by using the virtual reality device, and content information about the content, setting a first area and a second area different from the first area in the space; sensing the first area and the second area by using at least one image sensor, while the content is being reproduced; tracking an object located in the first area or the second area, based on a result of the sensing; and controlling a display of a screen of the virtual reality device, based on a result of the tracking.

[0005] According to an embodiment of the disclosure, a computer-readable recording medium having recorded thereon a program for executing the method may be provided.

[0006] According to an aspect of an example embodiment of the disclosure, provided is a virtual reality device including: at least one memory configured to store one or more instructions; at least one processor; at least one image sensor; a display engine; and a display, wherein the at least one processor is configured to execute the one or more instructions to: based on space information obtained by scanning a space in which content is to be viewed and content information about the content, set a first area and a second area different from the first area in the space; sense the first area and the second area by using the at least one image sensor, while the content is being reproduced; track an object located in the first area or the second area based on a result of the sensing; and control a display of a screen of the

virtual reality device by using the display engine and the display, based on a result of the tracking.

BRIEF DESCRIPTION OF DRAWINGS

[0007] The above and other aspects and features of the disclosure will become more apparent by describing in detail example embodiments thereof with reference to the attached drawings, in which:

[0008] FIG. 1 is a diagram illustrating an example of controlling a screen display of a virtual reality device by the virtual reality device, according to an example embodiment of the disclosure;

[0009] FIG. 2 is a flowchart for describing a method of controlling a virtual reality device, according to an example embodiment of the disclosure;

[0010] FIG. 3 is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure;

[0011] FIG. 4 is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of a virtual reality device, according to an example embodiment of the disclosure;

[0012] FIG. 5 is a diagram for describing an area range of a first area according to a type of content in a virtual reality device, according to an example embodiment of the disclosure;

[0013] FIG. 6 is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure;

[0014] FIG. 7 is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of a virtual reality device, according to an example embodiment of the disclosure;

[0015] FIG. 8 is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure;

[0016] FIG. 9 is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of a virtual reality device, according to an example embodiment of the disclosure;

[0017] FIG. 10 is a detailed flowchart of an operation of tracking an object located in a first area or a second area, according to an example embodiment of the disclosure;

[0018] FIG. 11 is a detailed flowchart of an operation of controlling a screen display of a virtual reality device, according to an example embodiment of the disclosure;

[0019] FIG. 12 is a diagram illustrating a virtual reality device controlling a screen display according to whether an object is located in a first area and a second area, according to an example embodiment of the disclosure;

[0020] FIG. 13 is a diagram illustrating an example in which a virtual reality device tracks an object by performing communication with a device associated with an object, according to an example embodiment of the disclosure;

[0021] FIG. 14 is a block diagram for describing a configuration of a virtual reality device, according to an example embodiment of the disclosure; and

[0022] FIG. 15 is a block diagram for describing a configuration of a server for performing communication with a virtual reality device, according to an example embodiment of the disclosure.

DETAILED DESCRIPTION

[0023] The terms used in the present specification will be briefly defined, and the disclosure will be described in detail. Throughout the disclosure, the expression “at least one of a, b or c” indicates only a, only b, only c, both a and b, both a and c, both b and c, all of a, b, and c, or variations thereof.

[0024] Although the terms used in the disclosure are selected from among common terms that are currently widely used in consideration of their functions in the disclosure, the terms may vary according to the intention of a person of ordinary skill in the art, a precedent, or the advent of new technology. Also, in particular cases, the terms are discretionally selected by the applicant of the disclosure, and the meaning of those terms will be described in detail in the corresponding part of the detailed description. Therefore, the terms used in the disclosure are not merely designations of the terms, but the terms are defined based on the meaning of the terms and content throughout the disclosure.

[0025] As used herein, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise. Unless otherwise defined, all terms including technical or scientific terms used herein may have the same meanings as commonly understood by a person of ordinary skill in the art of the present specification. It will be understood that, although the terms “first”, “second”, etc. may be used in the present specification to describe various elements, these elements should not be limited by these terms. The terms are only used to distinguish one element from another element.

[0026] Throughout the specification, when a part “includes” or “comprises” an element, unless there is a particular description contrary thereto, the part can further include other elements, not excluding the other elements. Also, the terms such as “unit,” “module,” or the like used in the specification indicate a unit, which processes at least one function or operation, and the unit or the module may be implemented by hardware or software, or by a combination of hardware and software.

[0027] Hereinafter, example embodiments of the disclosure will be described in detail with reference to the accompanying drawings to allow one of skill in the art to easily implement the embodiments. The disclosure may, however, be embodied in many different forms and should not be construed as being limited to an example embodiment set forth herein.

[0028] Hereinafter, example embodiments of the disclosure will be described in detail with reference to the drawings.

[0029] FIG. 1 is a diagram illustrating an example of controlling a screen display of a virtual reality device by the virtual reality device, according to an example embodiment of the disclosure. In particular, FIG. 1 is a diagram illustrating a virtual reality device 100 configured to control a screen display of the virtual reality device 100 when an object approaches while a user wearing the virtual reality device 100 watches content (e.g., virtual reality content) via the virtual reality device 100, according to an example embodiment of the disclosure.

[0030] In the disclosure, the virtual reality device 100 may be a device capable of expressing a virtual reality. The ‘virtual reality’ indicates that a virtual image is displayed in a digital environment space of a virtual world, or an image corresponding to a real world object and a virtual image are displayed together. Here, the virtual image may be a video or a still image. For example, the virtual image may be provided as a 360-degree image or a three-dimensional (3D) image. The virtual image may include content such as, for example, multimedia content including an audio and/or a subtitle. The virtual reality device 100 may be in a form of a head-mounted display (HMD) apparatus or a virtual reality helmet.

[0031] A server 200 provides a virtual reality service and/or a virtual reality service based content to the virtual reality device 100. The virtual reality service based content may be provided as virtual reality content. The virtual reality content may be reproduced by using the virtual reality device 100 and may deliver an immersive, 360-degree experience to the user. The server 200 may receive information related to the virtual reality service from the virtual reality device 100, and/or may transmit information related to the virtual reality service to the virtual reality device 100. The server 200 may provide a platform for the virtual reality service, and may provide the virtual reality service or the virtual reality service based content to the virtual reality device 100 of a user who is registered in the virtual reality service and/or subscribes to the virtual reality service. The virtual reality devices 100 may transmit and receive information with each other via the server 200, and the virtual reality devices 100 within a preset range may be connected to each other via direction communication with each other.

[0032] Referring to FIG. 1, the virtual reality device 100 according to an embodiment of the disclosure may set different areas in a space in which content (e.g., virtual reality service based content) is to be viewed (or replayed), and may track an object in the set areas. The virtual reality device 100 may control a screen display of the virtual reality device 100, according to whether an object is present in a first area or a second area which is set in the space in which content is viewed. The first area may be a space with a size required for a user wearing the virtual reality device 100 to immersively view or experience content, and corresponds to an immersive area. The second area may be a preset space for the user wearing the virtual reality device 100 to recognize an approach of an external object, and corresponds to a safe area.

[0033] Referring to what is shown in FIG. 1, when the user wears the virtual reality device 100 and plays a game, the virtual reality device 100 may sense the first area and the second area which are set in the space in which content is viewed. As the user wearing the virtual reality device 100 is in a light-shielded state in which an external environment is not seeable by the user, the virtual reality device 100 may sense a surrounding environment by using a camera, a microphone, etc.

[0034] When an object such as another user outside the second area enters the second area, the virtual reality device 100 may detect and track the object in the second area. When the virtual reality device 100 recognizes that the object enters the second area, the virtual reality device 100 may identify the object and may display information about the identified object on a part of a game screen, thereby inform-

ing the user. While the user wears the virtual reality device **100**, the user may recognize the object located in the second area.

[0035] When the object located in the second area enters the first area, the virtual reality device **100** may recognize that the object enters the first area, and may switch the game screen to a see-through full screen and display the switched screen. Additionally or alternatively, the virtual reality device **100** may end displaying of the game screen, and instead, may capture a real world by using a camera of the virtual reality device **100** and display a captured image of the real world on a display of the virtual reality device **100** in real time. Accordingly, the user may recognize the external environment while the user wears the virtual reality device **100**.

[0036] Hereinafter, a method of controlling the virtual reality device **100** to control a screen display of the virtual reality device **100** according to whether an external object enters preset areas set in a space in which content is viewed, and to recognize an object entering the preset areas while the virtual reality device **100** is worn on a user, and the virtual reality device **100** performing the method will now be described.

[0037] FIG. 2 is a flowchart for describing a method of controlling the virtual reality device **100**, according to an example embodiment of the disclosure.

[0038] The virtual reality device **100** may set a first area and a second area different from the first area in a space in which content is to be viewed, based on space information obtained by scanning the space in which the content is to be viewed and content information about the content (**S210**). The virtual reality device **100** may provide content of various fields including a movie, education, sports, a game, etc. The space information may be information obtained by scanning the space for surrounding topography and/or a surrounding object by using at least one sensor (e.g., at least one image sensor) included in the virtual reality device **100**, wherein the space is to be used when the user wearing the virtual reality device **100** watches the content in the space. An area range of the first area may vary according to a type of the content, and the second area may have a preset area range outside the first area. For convenience of descriptions, in an embodiment of the disclosure, an example in which a total of two areas including the first area and the second area will now be described, but the disclosure is not limited thereto, and a total of N (N being a natural number equal to or greater than 3) areas from the first area up to an N-th area may be set. In a case where the virtual reality device **100** sets the total of N areas in a space in which content is to be viewed, whenever an object enters each area, a screen display of the virtual reality device **100** may be differently controlled. Hereinafter, with reference to FIGS. 3 to 9, a method for setting a first area and a second area in a space in which content is to be viewed will now be described in detail.

[0039] FIG. 3 is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure.

[0040] With reference to FIG. 3, an example in which the virtual reality device **100** directly senses a space in which content is to be viewed, by using at least one image sensor, will now be described.

[0041] The virtual reality device **100** may sense the space in which the content is to be viewed, based on a reproduction input (or a request to reproduce or replay) for the content being received (**S310**). The virtual reality device **100** may sense a surrounding environment, by using an image sensor such as a camera or a light detection and ranging (LiDAR) included in the virtual reality device **100**.

[0042] For example, the virtual reality device **100** may scan the space in which the content is to be viewed (or replayed), by using at least one image sensor. The virtual reality device **100** may obtain depth information from an image acquired by scanning the space. The virtual reality device **100** may obtain a three-dimensional scan result about the space in which the content is to be viewed, by using a depth map including depth information and a plurality of captured images. As another example, the virtual reality device **100** may obtain the three-dimensional scan result by using a plurality of captured images of the space in which the content is to be viewed.

[0043] The virtual reality device **100** may determine a first area and a second area, based on space information according to the sensing and content information about the content for which the reproduction input is received (**S320**). The virtual reality device **100** may determine an area range of the first area and an area range of the second area, based on the space information obtained by scanning the space in which the content is to be viewed, and the content information about the content selected by a user. The content information about the content may include, for example but not limited to, a title of the content, a type or field of the content, a method of watching or experiencing the content, a distance requested for immersion in the content, a safety distance requested for safely executing the content, etc. The content information about the content may be included in a form of metadata in an execution file of an application corresponding to each content, or may be obtained from substance of the content or an external device. For example, the virtual reality device **100** may analyze the content selected by the user, and may set the first area by determining whether the user, when wearing the virtual reality device **100**, is expected to move much or the content selected by the user requires a large area while the content is being reproduced. The virtual reality device **100** may set the first area, and then may set the second area to a larger area than the first area. For example, the second area may be preset to have a certain size compared to the first area, e.g., 200% of a size of the first area. For example, the second area may be preset to have a certain position relationship with a position of the first area.

[0044] Furthermore, the virtual reality device **100** may obtain information about an object that is allowed to be located in the second area (**S330**). The user of the virtual reality device **100** may have registered object information with respect to an object that is expected and/or allowed to enter the second area while the content is being reproduced. The object information may include, for example but not limited to, object identification information, image information such as an image or an avatar of the object, affiliation information of the object, etc.

[0045] The virtual reality device **100** may transmit information about the first area, information about the second area, and the obtained information about the allowed object to the server **200** that provides content (**S340**). By storing the information in the server **200**, the virtual reality device **100**

may use this information and simply and rapidly perform a process of setting the first area and the second area when reproducing the same or similar content later.

[0046] FIG. 4 is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of the virtual reality device 100, according to an example embodiment of the disclosure.

[0047] Referring to FIG. 4, a user using (e.g., wearing) the virtual reality device 100 may execute an application corresponding to content to be reproduced from among a plurality of pieces of content in various fields and genres displayed on a display of the virtual reality device 100 (S400). For example, one or more of the plurality of pieces of the content may be displayed on a home screen on the display of the virtual reality device 100.

[0048] Before the virtual reality device 100 reproduces the user-selected content, the virtual reality device 100 may obtain space information by sensing a space in which the content is to be viewed (S410).

[0049] The virtual reality device 100 may set the first area and the second area in the space in which the content is to be viewed, based on the obtained space information and content information about the content selected according to a user input (S420).

[0050] The user wearing the virtual reality device 100 (or user of the virtual reality device 100) may register information about an allowed object that is expected and/or allowed to enter the second area (S430). The user of the virtual reality device 100 may add and/or remove an allowed object, and may input information about an allowed object.

[0051] The virtual reality device 100 may transmit information about a set area and/or the information about the allowed object to the server 200 that provides the content selected according to the user input (S440). Afterward, when the user of the virtual reality device 100 requests again the server 200 for execution (e.g., reproduction) of the content, the virtual reality device 100 may receive the information about the set area or the information about the allowed object from the server 200, and thus, may not perform operations of S410 to S440.

[0052] The virtual reality device 100 may set the first area and the second area in the space in which the content is to be viewed, and then may display a content reproduction screen, according to a content reproduction start request from the user (S450). While the content is being reproduced, the virtual reality device 100 may sense the first area and the second area by detecting a surrounding environment by using at least one sensor.

[0053] FIG. 5 is a diagram for describing an area range of a first area according to a type of content in the virtual reality device 100, according to an example embodiment of the disclosure.

[0054] Referring to (a), (b), and (c) of FIG. 5, it would be understood that the area range of the first area may vary, according to a type of the content. For example, in a case of first-type content including a movie, a racing game, etc., the virtual reality device 100 may consider a real-world object such as a chair on which the user may sit, and may set the first area by considering an area corresponding to the chair. As another example, in a case of a second-type content including a dance or rhythm game, the virtual reality device 100 may set the first area around a location of the user of that virtual reality device 100. In this regard, when an obstacle is

present in the first area to be set, the virtual reality device 100 may newly set the first area, and may induce the user wearing the virtual reality device 100 to enter the newly set first area (e.g., output a sound and/or display a message requesting the user to move). As another example, in a case of a third-type content including a boxing or sandbox-type game, the user is expected to have lots of movements, and thus, in order to secure the first area with a large range, the virtual reality device 100 may induce the user wearing the virtual reality device 100 to put away an obstacle.

[0055] FIG. 6 is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure.

[0056] FIG. 6 shows an example in which the virtual reality device 100 receives, from the external server 200, information related to setting a first area and a second area, and sets the first area and the second area based on the received information.

[0057] In response to receiving a reproduction input for content having an execution history, the virtual reality device 100 may receive information about the first area and information about the second area from the server 200 that provides the content having the execution history (S510). For example, when the user selected the same or similar to content that was previously executed, the virtual reality device 100 may request the information about the first area and the information about the second area, related to the previously executed content, from the server 200 that provides the content. The server 200 may obtain the information about the first area and the information about the second area which are stored in the server 200, in response to the request from the virtual reality device 100, and may transmit the information to the virtual reality device 100.

[0058] The virtual reality device 100 may determine the first area and the second area, based on the information about the first area and the information about the second area which are received from the server 200 (S520). In this case, without an operation for scanning a space in which content is to be viewed and/or analyzing user-selected content, an area range of the first area and an area range of the second area may be determined.

[0059] The virtual reality device 100 may further receive information about a pre-registered allowed object from the server 200. The virtual reality device 100 may check whether an object located in the second area is an object pre-registered as an allowed object, by using the allowed object information received from the server 200.

[0060] FIG. 7 is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of the virtual reality device 100, according to an example embodiment of the disclosure.

[0061] Referring to FIG. 7, a user wearing the virtual reality device 100 may execute an application corresponding to content to be reproduced from among a plurality of pieces of content in various fields and genres in a home screen displayed on a display of the virtual reality device 100 (S600).

[0062] In response to receiving a reproduction input for content having an execution history, the virtual reality device 100 may perform communication with the server 200 that provides the content having the execution history. The virtual reality device 100 may receive information about a

first area and information about a second area from the server **200** that provides the content having the execution history (**S610**).

[0063] The virtual reality device **100** may set the first area and the second area, based on the information about the first area and the information about the second area which are received from the server **200** (**S620**).

[0064] The virtual reality device **100** may set the first area and the second area in the space in which the content is to be viewed, and then may display a content reproduction screen, according to a content reproduction start request from the user (**S630**). While the content is being reproduced, the virtual reality device **100** may sense the first area and the second area by detecting a surrounding environment by using at least one sensor.

[0065] FIG. **8** is a detailed flowchart of an operation of setting a first area and a second area in a space in which content is to be viewed, according to an example embodiment of the disclosure.

[0066] In response to receiving a reproduction input for content, the virtual reality device **100** may determine a first area and a second area, based on space information obtained by sensing, by using at least one image sensor, a space in which the content is to be viewed, and content information about the content for which the reproduction input is received (**S710**).

[0067] The virtual reality device **100** may adjust the first area and the second area, according to an input of a user of the virtual reality device **100** (**S720**). According to a user input, the virtual reality device **100** may manually adjust the first area and the second area which were automatically determined.

[0068] FIG. **9** is a diagram illustrating an example of a method for setting a first area and a second area in a space in which content is to be viewed, on a screen of the virtual reality device **100**, according to an example embodiment of the disclosure.

[0069] Referring to FIG. **9**, a user wearing the virtual reality device **100** may execute an application corresponding to content to be reproduced from among a plurality of pieces of content in various fields and genres in a home screen displayed on a display of the virtual reality device **100** (**S800**).

[0070] The virtual reality device **100** may determine a first area and a second area, based on space information obtained by sensing a space in which the content is to be viewed, and content information about the content for which a reproduction input is received (**S810**).

[0071] The virtual reality device **100** may specify and display the first area and the second area which are automatically determined, may provide a tool for editing the first area and the second area, and may receive an input of adjusting the first area and the second area from the user (**S820**).

[0072] The virtual reality device **100** may set the first area and the second area in the space in which the content is to be viewed, and then may display a content reproduction screen, according to a content reproduction start request from the user (**S830**). While the content is being reproduced, the virtual reality device **100** may sense the first area and the second area that has been adjusted by detecting a surrounding environment by using at least one sensor.

[0073] Referring back to FIG. **2**, the virtual reality device **100** may sense the first area and the second area by using at

least one image sensor (**S220**). The virtual reality device **100** may sense the first area and the second area by using the image sensor provided at a portion of the virtual reality device **100**, e.g., an upper part, a front surface, a rear surface, and/or a side part of the virtual reality device **100**. Also, the virtual reality device **100** may obtain a sound and/or a voice which occurs in a surround environment, by using the microphone included in the virtual reality device **100**.

[0074] The virtual reality device **100** may track an object located in the first area or the second area, based on a result of the sensing (**S230**). Hereinafter, this will now be described in detail with reference to FIG. **10**.

[0075] FIG. **10** is a detailed flowchart of an operation of tracking an object located in a first area or a second area, according to an example embodiment of the disclosure.

[0076] The virtual reality device **100** may detect an object, based on a result of sensing using at least one image sensor (**S910**). Also, the virtual reality device **100** may detect the object, additionally based on a sound and/or a voice obtained by using the microphone. For example, the virtual reality device **100** may identify a direction in which the sound and/or the voice has occurred, and may identify a strength of the sound and/or the voice. The virtual reality device **100** may determine a location of the object, and a distance from the virtual reality device **100**, based on the direction and the strength of the sound and/or the voice.

[0077] When the detected object is located in the second area, the virtual reality device **100** may determine whether communication with a device associated with (e.g., possessed or controlled) the object located in the second area is available (**S920**).

[0078] As a result of the determination, when the communication with the device associated with the object located in the second area is available, the virtual reality device **100** may receive object location information and user information from the device associated with the detected object (**S930**). However, when the detected object does not have the device or the communication may not be available with the device, operations of **S920** and **S930** may be skipped.

[0079] When the communication with the device associated with the object located in the second area is not available, the virtual reality device **100** may track the detected object, based on the result of sensing using the at least one sensor, and when the communication is available, the virtual reality device **100** may track the detected object, based on the result of sensing using the at least one sensor and further based on the object location information and the user information received from the device associated with the detected object (**S940**).

[0080] Referring back to FIG. **2**, the virtual reality device **100** may control a screen display of the virtual reality device **100**, based on a result of the tracking (**S240**). Hereinafter, this will now be described in detail with reference to FIGS. **11** to **13**.

[0081] FIG. **11** is a detailed flowchart of an operation of controlling screen display of the virtual reality device **100**, according to an example embodiment of the disclosure.

[0082] The virtual reality device **100** may determine whether a tracked object is located in a first area or a second area, and may display a screen of the virtual reality device **100**, according to a screen display mode based on a result of the determination. FIG. **11** will now be described based on the assumption that, after a user determines that an external

object that may interrupt immersion in content is not present in a space in which the content is to be viewed, the user wears the virtual reality device **100** and watches the content in the space.

[0083] The virtual reality device **100** may determine whether an object is located in the second area (**S1010**). The virtual reality device **100** may determine whether a tracked object enters the second area. When there is no object that has entered the second area, the virtual reality device **100** may continuously detect and track an object from a result of sensing the first area and the second area.

[0084] When an object is located in the second area, the virtual reality device **100** may identify the object (**S1020**). For example, the virtual reality device **100** may obtain an image via at least one image sensor, and may identify the object, according to classification information and appearance information of the object, based on feature information extracted from the obtained image. For example, the virtual reality device **100** may input feature vectors to an image classification model, an object localization model, an object detection model, etc. which include a deep neural network (DNN), a convolutional neural network (CNN), a recurrent neural network (RNN), a bidirectional recurrent deep neural network (BRDNN), etc., thereby performing target classification, appearance information measurement, objection detection, or the like. The virtual reality device **100** may classify an object according to image classification, may measure appearance information by localizing the object with a bounding box, and thus, may identify the object. Also, the virtual reality device **100** may identify an object, based on utterance content of the object which is obtained via the microphone. For example, the virtual reality device **100** may obtain identification information such as a relation with the user of the virtual reality device **100**, a name of the object, etc. from the utterance content of the object.

[0085] The virtual reality device **100** may determine whether the identified object is an object pre-registered as an allowed object (**S1030**). The user of the virtual reality device **100** may have registered object information with respect to the object that is expected and/or allowed to enter the second area. The virtual reality device **100** may compare information of the identified object with information of the allowed object, and thus, may determine whether the identified object is a pre-registered object.

[0086] When the identified object is the pre-registered object, the virtual reality device **100** may display an indicator corresponding to the object on a content reproduction screen (**S1040**). As the identified object is the allowed object, the virtual reality device **100** may generate the indicator corresponding to the identified object, based on the identification information of the object pre-registered as the allowed object, image information such as a photo or an avatar of the object, affiliation information of the object, etc., and may display the indicator on a part of the content reproduction screen. The indicator may be, for example, in a form of an icon or a thumbnail.

[0087] When the identified object is not the pre-registered object, the virtual reality device **100** may display a see-through partial screen on the content reproduction screen (**S1050**). As the virtual reality device **100** does not have identification information about the identified object, the virtual reality device **100** may display the see-through partial

screen on a part of the content reproduction screen such that the user may directly identify the object located in the second area.

[0088] The virtual reality device **100** may determine whether the object is located in the first area (**S1060**). The virtual reality device **100** may determine whether the tracked object enters from the second area to the first area. When there is no object that has entered the first area, the virtual reality device **100** may continuously track the object located in the second area, and may continuously display information about the identified object on a part of the content reproduction screen (e.g., as the indicator or as the see-through partial screen).

[0089] When the tracked object has entered from the second area to the first area, and thus, is located in the first area, the virtual reality device **100** may switch the content reproduction screen to a see-through full screen and display the object (**S1070**). As a situation in which the user cannot immerse in the content occurs, the virtual reality device **100** may end the content reproduction screen, and may display the see-through full screen for the user to check an external environment or the object while the user is wearing the virtual reality device **100**.

[0090] FIG. **12** is a diagram illustrating the virtual reality device **100** controlling a screen display according to whether an object is located in a first area and a second area, according to an example embodiment of the disclosure.

[0091] The virtual reality device **100** may provide user-selected content on a display of the virtual reality device **100**, according to a content reproduction start request from a user wearing the virtual reality device **100**. Accordingly, the user wearing the virtual reality device **100** may immerse in and watch the content in a light-shielded mode in which the user cannot see an external environment.

[0092] Referring to FIG. **12**, when there is no object located in the first area or the second area in a space in which the content is to be viewed, the virtual reality device **100** may display only a content reproduction screen such that the user may continuously immerse in the content.

[0093] When an object is identified in the second area in the space in which the content is viewed, the virtual reality device **100** may display a screen of the virtual reality device **100** according to screen display modes of two types, based on whether the object is a pre-registered object.

[0094] When the identified object is a pre-registered object, the virtual reality device **100** may display an indicator corresponding to the object on the content reproduction screen. The indicator may be generated, based on identification information of the object, image information such as a photo or an avatar of the object, affiliation information of the object, etc. The indicator may be displayed on a part of the content reproduction screen. In an embodiment, a location of the indicator on the content reproduction screen may be determined based on at least one of a location, a movement direction, or a movement speed of the identified object. For example, when the identified object is located in a north direction in the second area and then moves in a west direction, the indicator may be displayed in the north direction in the content reproduction screen and then moved in the west direction. As illustrated in FIG. **12**, when two or more objects are located in the second area, indicators respectively corresponding to the two or more

objects may be displayed on corresponding locations of the content reproduction screen, in consideration of locations of the two or more objects.

[0095] When the identified object is not a pre-registered object, the virtual reality device 100 may display a see-through partial screen on the content reproduction screen. The see-through partial screen may be displayed on a part of the content reproduction screen, and a location of the see-through partial screen on the content reproduction screen may be determined, based on at least one of a location, a movement direction, or a movement speed of the identified object. For example, when the identified object is located in a south direction in the second area and then moves in an east direction, the see-through partial screen may be displayed in the south direction in the content reproduction screen and then moved in the east direction.

[0096] When an object is identified in the first area in the space in which the content is viewed, the virtual reality device 100 may switch and display the content reproduction screen to a see-through full screen. The virtual reality device 100 may end the content reproduction screen, and may display the see-through full screen for the user to check an external environment or the object while the user is wearing the virtual reality device 100. However, when the object located in the first area corresponds to an object pre-registered as an exceptional object, for example, when the object is a pet such as a dog or a cat, the virtual reality device 100 may not switch to the see-through full screen by performing processing related to the exceptional object, and may maintain the content reproduction screen or may display an indicator corresponding to the exceptional object on the content reproduction screen.

[0097] FIG. 13 is a diagram illustrating an example in which the virtual reality device 100 tracks an object by performing communication with a device associated with the object located in a second area, and displays an indicator corresponding to the object on a content reproduction screen, according to an example embodiment of the disclosure.

[0098] When the object is located in the second area, the virtual reality device 100 may determine whether it is available to communicate with the device associated with the object, and as a result of the determine, when it is available to communicate with the device associated with the object located in the second area, the virtual reality device 100 may receive location information of the object and user information from the device associated with the object. Based on a sensing result of the at least one image sensor and the location information of the object and the user information which are received from the device associated with the detected object, the virtual reality device 100 may display the indicator corresponding to the object on a part of the content reproduction screen.

[0099] Referring to FIG. 13, a first object and a second object have entered the second area, and the virtual reality device 100 may transmit a message as to whether it is possible to perform communication, to a device 310 (e.g., a smartphone) of the first object and a device 320 (e.g., a virtual reality device) of the second object, and may receive response messages corresponding thereto. As illustrated in FIG. 13, object device information may be additionally displayed at a bottom right of indicators respectively corresponding to the first object and the second object, but the disclosure is not limited thereto. A location of the indicator

on the content reproduction screen may be determined, based on at least one of a location, a movement direction, or a movement speed of the identified object.

[0100] FIG. 14 is a block diagram for describing a configuration of the virtual reality device 100, according to an example embodiment of the disclosure. What are described above with respect to the method of controlling the virtual reality device 100 according to one or more example embodiments may be applied to the virtual reality device 100 even though they are not described below.

[0101] Referring to FIG. 14, the virtual reality device 100 may include a memory 110, a processor 120, an image sensor 130, a display engine 140, a display 150, a gaze pursuit sensor 160, a communication interface 170, and an input device 180. In addition, a location sensor for sensing a location of the virtual reality device 100 or a power supply for supplying power to the virtual reality device 100 may be further included, and a person of ordinary skill in the art related to an embodiment of the disclosure would understand that other general-purpose elements other than elements shown in FIG. 14 may be further included. In addition, each of the above elements may be provided in singular or plural.

[0102] The memory 110 may store instructions that are executable by the processor 120. The memory 110 may store a program consisting of instructions. The memory 110 may include at least one type of hardware devices including a random access memory (RAM), a static RAM (SRAM), a read-only memory (ROM), a flash memory, an electrically erasable programmable ROM (EEPROM), a programmable ROM (PROM), a magnetic memory, a magnetic disk, and an optical disk.

[0103] The memory 110 may store at least one software module including instructions. Each software module may be executed by the processor 120 to cause the virtual reality device 100 to perform a preset operation or function. For example, a space sensing module, an object tracking module, a screen display control module, etc. may be executed by the processor 120, but the disclosure is not limited thereto, and other software modules may be further included.

[0104] The processor 120 may execute instructions stored in the memory 110 or a programmed software module to control an operation or function performed by the virtual reality device 100. The processor 120 may be configured as a hardware element for performing arithmetic, logic, and input and output computations, signal processing.

[0105] The processor 120 may be configured as at least one of a central processing unit (CPU), a microprocessor, a graphic processor unit, application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), an application processor, a neural processing unit, or an artificial intelligence-dedicated processor designed to have a hardware structure specialized for processing an artificial intelligence model, but the disclosure is not limited thereto. Each of processors constituting the processor 120 may be a dedicated processor for performing a preset function.

[0106] The image sensor 130 may be a device for capturing a real-world scene, and may be stereo cameras or a single camera. Also, the image sensor 130 may be a depth camera for sensing depth information or a sensor in a form of a LiDAR. The virtual reality device 100 may include the

image sensor **130** in plural to respectively corresponding to functions. For example, a first camera for three-dimensionally (3D) scanning a real-world object, a second camera for performing capturing in a direction with a specific angle, a third camera for obtaining depth information, etc. may be included.

[0107] The virtual reality device **100** may control a screen display via the display engine **140** and the display **150**. A virtual image may be generated via an optical engine, and may include both a static image and a dynamic image. The virtual image may be an image shown to a user via the virtual reality device **100** in a virtual space, and may be an image of content, a real-world object image captured by capturing a real-world scene, or an image indicating information or a control menu with respect to an operation of the virtual reality device **100**.

[0108] The display engine **140** may include an optical engine for generating and projecting a virtual image, and a guide unit for leading, to the display **150**, light of the virtual image projected from the optical engine.

[0109] The display **150** may display the image of content, the real-world object image, or a virtual image such as the image indicating the information or the control menu with respect to the operation of the virtual reality device **100**. When the virtual image is displayed via the display **150**, a user wearing the virtual reality device **100** may manipulate the virtual image via the image sensor **130**, the gaze pursuit sensor **160**, or the input device **180**, to thereby manipulate the virtual image.

[0110] The gaze pursuit sensor **160** may detect gaze information including a gaze direction in which user's eyes gaze, pupil locations of the user's eyes, coordinates of a center point of each pupil, or the like. For example, the gaze pursuit sensor **160** may detect a pupil from an image captured by receiving received light by irradiating infrared light to an eye of the user, and thus, may pursue its movement. The processor **120** may determine an eye movement form, based on the gaze information of the user which is detected by the gaze pursuit sensor **160**. For example, the processor **120** may determine various forms of eye movements including fixation of gazing one point, pursuit of tracking a moving object, saccade of rapidly moving a gaze from one gaze point to another gaze point, etc. The processor **120** of the virtual reality device **100** may determine a gaze point of the user or gaze movement of the user by using the gaze pursuit sensor **160**, and thus, may use them in control of the virtual reality device **100**.

[0111] The communication interface **170** may be connected to a device located outside the virtual reality device **100**, and thus, may transmit information obtained or generated by the virtual reality device **100** to the device located outside or may receive various types of information from the device located outside. For example, the device located outside may be the server **200** or a user terminal (not shown). The communication interface **170** may perform communication with other device or a network. To do so, the communication interface **170** may include a communication module configured to support at least one of various communication methods. For example, the communication module configured to perform short-range communication such as wireless fidelity (Wi-Fi), Bluetooth, etc., various types of mobile communication, or ultra wideband communication.

[0112] The input device **180** may receive an input of the user of the virtual reality device **100**. For example, the input

device **180** may be a touch screen, a microphone for receiving voice of the user, or a motion sensor for sensing a motion of the user, but the disclosure is not limited thereto. According to an embodiment, the input device **180** may be replaced in a manner that the input of the user is received by using the image sensor **130** and the display engine **140**. For example, the processor **120** may obtain gaze coordinates, based on the gaze information obtained using the gaze tracking sensor **160**. The processor **120** may recognize a gesture of selecting a virtual image corresponding to the gaze coordinates, based on an image captured via the image sensor **130**.

[0113] According to the configuration, the processor **120** according to an embodiment of the disclosure may execute one or more instructions stored in the memory **110** to control all operations for controlling the virtual reality device **100**.

[0114] The processor **120** according to an embodiment of the disclosure or a first processor configuring the processor **120** may execute the space sensing module to set a first area and a second area different from the first area in a space in which content is to be viewed, based on space information about the space in which the content is to be viewed and content information about the content. The processor **120** or the first processor may sense or scan the first area and the second area by using at least one image sensor **130**. The first area may be determined based on the space information and the content information, and the second area may be determined based on the space information.

[0115] According to an embodiment, the processor **120** or the first processor may sense the space in which the content is to be viewed, by using the at least one image sensor **130**, based on a reproduction input for the content being received via the input device **180**. The processor **120** or the first processor may determine the first area and the second area, based on the space information according to the sensing and the content information about the content for which the reproduction input is received. Also, the processor **120** or the first processor may obtain, via the input device **180**, information about an allowed object that may be located in the second area. The processor **120** or the first processor may transmit, via the communication interface **170**, information about the first area, information about the second area, and the obtained information about the allowed object to the server **200** that provides content.

[0116] According to an embodiment, in response to receiving, via the input device **180**, a reproduction input for content having an execution history, the processor **120** or the first processor may receive, via the communication interface **170**, information about the first area and information about the second area from the server **200** that provides the content having the execution history. The processor **120** or the first processor may determine the first area and the second area, based on the received information about the first area and the received information about the second area. In a case where the server **200** stores a content watching history of the virtual reality device **100**, when there is a request for content with a watching history from the virtual reality device **100**, the server **200** may look up the information about the first area and the second area which were previously set, and may transmit the information to the virtual reality device **100**. In this case, the virtual reality device **100** may skip some processes of setting the first area and the second area.

[0117] According to an embodiment, the processor **120** or the first processor may determine the first area and the

second area, based on the space information and the content information about the content, and may adjust the first area and the second area, according to an input of the user of the virtual reality device **100** via the input device **180**. The processor **120** or the first processor may differently set an area range of the first area, according to a type of the content included in the content information.

[0118] According to an embodiment of the disclosure, the processor **120** or a second processor configuring the processor **120** may execute the object tracking module, and may track an object located in the first area or the second area, based on a result of sensing the first area and the second area. The processor **120** or the second processor may sequentially detect the object in the first area or the second area, and thus, may identify at least one of a current location, a movement direction, or a movement speed of the object.

[0119] According to an embodiment, the processor **120** or the second processor may detect the object, and may determine whether it is available to communicate with a device associated with the object located in the second area. As a result of the determination, when the communication with the device the object located in the second area is not available, the processor **120** or the second processor may track the detected object, based on the sensing result, and when the communication is available, the processor **120** or the second processor may track the detected object, based on the sensing result, and location information of the object and user information which are received from the device associated with the object via the communication interface **170**.

[0120] According to an embodiment, the processor **120** or a third processor configuring the processor **120** may execute the screen display control module, and may control a screen display of the virtual reality device **100**, by using the display engine **140** and the display **150**, based on a result of tracking an object located in the first area or the second area.

[0121] According to an embodiment, the processor **120** or the third processor may determine whether the object is located in the first area or the second area. The processor **120** or the third processor may display a screen of the virtual reality device **100** by controlling the display engine **140** and the display **150**, according to a screen display mode based on a result of the determination.

[0122] According to an embodiment, when the object is located in the second area, the processor **120** or the third processor may identify the object, and thus, may determine whether the identified object is an object pre-registered as an allowed object. When the identified object is the pre-registered object, the processor **120** or the third processor may display an indicator corresponding to the object on a content reproduction screen, and when the identified object is not the pre-registered object, the processor **120** or the third processor may control the display engine **140** and the display **150** to display a see-through partial screen on the content reproduction screen. The processor **120** or the third processor may determine a location of the indicator or the see-through partial screen on the content reproduction screen, based on at least one of a location, a movement direction, or a movement speed of the identified object.

[0123] According to an embodiment, when the object is located in the first area, the processor **120** or the third processor may control the display engine **140** and the display **150** to switch the content reproduction screen to a see-through full screen. When the content reproduction screen is switched to the see-through full screen, displaying

of the content being reproduced may be ended, and an image obtained by capturing a real-world may be displayed on the display **150** of the virtual reality device **100** in real time to cause a user wearing the virtual reality device **100** to have a feeling of directly seeing a real-world scene.

[0124] When the user wearing the virtual reality device **100** checks the object having entered the first area via the see-through full screen, and then performs an input or a gesture for reproducing the content again, the see-through full screen may be switched to the content reproduction screen, thereby resume the displaying the content being reproduced. Here, the indicator or the see-through partial screen may be displayed on the content reproduction screen according to user's setting, or may not be displayed on the content reproduction screen. For example, the indicator or the see-through partial screen may not be displayed in a case the user determines it is acceptable for the checked object to be present in the first area.

[0125] FIG. **15** is a block diagram for describing a configuration of the server **200** for performing communication with the virtual reality device **100**, according to an example embodiment of the disclosure.

[0126] Referring to FIG. **15**, the server **200** includes a memory **210**, a processor **220**, a communication interface **230**, and storage **240**. A person of ordinary skill in the art related to an embodiment would understand that other general-purpose elements other than elements shown in FIG. **15** may be further included.

[0127] Each element of the block diagram of FIG. **15** may be separated, added, or skipped, according to implementation of the server **200**. For example, according to an implementation scheme, one element may be divided into two or more elements, two or more elements may be combined into one element, and some elements may be further added or removed.

[0128] The server **200** may be a device for providing a virtual reality service, and may provide a virtual reality service platform. Alternatively, the server **200** may be a device for providing content, and may provide content based on the virtual reality service.

[0129] The memory **210** may store instructions that are executable by the processor **220**. The memory **210** may store software or a program.

[0130] The processor **220** may execute the instructions stored in the memory **210**. The processor **220** may perform overall control of the server **200**. The processor **220** may obtain information and requests received via the communication interface **230**, and may store the received information in the storage **240**. Also, the processor **220** may process the received information. For example, the processor **220** may perform an operation of obtaining information to be used in a second external device from information received from a first external device or processing the received information. Also, the processor **220** may transmit the information received from the first external device to the second external device.

[0131] The communication interface **230** may perform communication with an external device such as the virtual reality device **100**. The server **200** may receive information related to a virtual reality service from the virtual reality device **100**, and may transmit information related to a virtual reality service, in response to a request from the virtual reality device **100**. For example, the server **200** may receive information about a first area, information about a second

area, and information about an allowed object from the virtual reality device **100**, and may store received information for each virtual reality device **100**.

[0132] The storage **240** may store various items of software and information. For example, the storage **240** may store various items of data or information used in providing a program, an application, and a virtual reality service which are executed in the server **200**.

[0133] The server **200** may serve as a medium device through which the virtual reality devices **100** within a preset range exchange information. To do so, the server **200** may previously register information about the virtual reality device **100** for each user in the storage **240**, and may update information related to a virtual reality service. The server **200** may transfer a virtual reality service, to which information received from the virtual reality device **100** is reflected, to other virtual reality device **100**.

[0134] Embodiments of the disclosure may be embodied as a computer-readable recording medium, e.g., a program module to be executed in computers, which includes computer-readable instructions. The computer-readable recording medium may include any usable medium that may be accessed by computers, volatile and non-volatile medium, and detachable and non-detachable medium. Also, the computer-readable recording medium may include a computer storage medium and a communication medium. The computer storage medium includes all volatile and non-volatile media, and detachable and non-detachable media which are technically implemented to store information including computer-readable instructions, data structures, program modules or other data. The communication medium may include computer-readable instructions, a data structure, a program module, or other data such as modulation-type data signals.

[0135] Also, the computer-readable recording medium may be provided in a form of a non-transitory recording medium. Here, the term “non-transitory storage medium” may mean that the storage medium is a tangible device and does not include signals (e.g., electromagnetic waves), and may mean that data may be permanently or temporarily stored in the storage medium. For example, the “non-transitory storage medium” may include a buffer in which data is temporarily stored.

[0136] According to an embodiment, the method according to various embodiments of the disclosure may be included and provided in a computer program product. The computer program product may be traded as a product between a seller and a buyer. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., a compact disc read only memory (CD-ROM)) or may be distributed (e.g., downloaded or uploaded) online through an application store or directly between two user apparatuses (e.g., smartphones). In a case of online distribution, at least a portion of the computer program product (e.g., a downloadable application) may be at least temporarily stored or temporarily generated in a machine-readable storage medium such as a manufacturer's server, a server of an application store, or a memory of a relay server.

[0137] According to an embodiment of the disclosure, a method of controlling the virtual reality device **100** is provided. The method of controlling the virtual reality device **100** may include setting a first area and a second area different from the first area in a space in which content is to

be viewed, based on space information about the space in which the content is to be viewed and content information about the content (**S210** in FIG. 2). Also, the method of controlling the virtual reality device **100** may include sensing the first area and the second area by using the at least one image sensor **130** (**S220** in FIG. 2). Also, the method of controlling the virtual reality device **100** may include tracking an object located in the first area or the second area, based on a result of the sensing (**S230** in FIG. 2). Also, the method of controlling the virtual reality device **100** may include controlling screen display of the virtual reality device **100**, based on a result of the tracking (**S240** in FIG. 2).

[0138] According to an embodiment of the disclosure, the controlling of the screen display of the virtual reality device **100** (**S240**) may include determining whether the object is located in the first area or the second area (**S1010**, **S1060** in FIG. 11). Also, the controlling of the screen display of the virtual reality device **100** (**S240**) may include displaying a screen of the virtual reality device **100**, according to a screen display mode based on a result of the determining (**S1040**, **S1050**, **S1070** in FIG. 11).

[0139] Also, the displaying of the screen of the virtual reality device **100** (**S1040**, **S1050**, **S1070** in FIG. 11) may include, when the object is located in the second area (**S1010** in FIG. 11), identifying the object, and determining whether the identified object is an object pre-registered as an allowed object (**S1020**, **S1030** in FIG. 11). Also, the displaying of the screen of the virtual reality device **100** (**S1040**, **S1050**, **S1070**) may include, based on a result of the determining, when the identified object is the pre-registered object, displaying an indicator corresponding to the object on a content reproduction screen, and when the identified object is not the pre-registered object, displaying a see-through partial screen on the content reproduction screen (**S1040**, **S1050** in FIG. 11). Also, the displaying of the screen of the virtual reality device **100** (**S1040**, **S1050**, **S1070**) may include, when the object is located in the first area (**S1060** in FIG. 11), switching the content reproduction screen to a see-through full screen (**S1070**).

[0140] Also, a location of the indicator or the see-through partial screen on the content reproduction screen may be determined based on at least one of a location, a movement direction, or a movement speed of the object.

[0141] According to an embodiment of the disclosure, the tracking of the object (**S230**) may include detecting the object (**S910** in FIG. 10). Also, the tracking of the object (**S230**) may include determining whether communication with a device associated with the object located in the second area is available (**S920** in FIG. 10). Also, the tracking of the object (**S230**) may include, based on a result of the determining, when the communication with the device associated with the object located in the second area is not available, tracking the detected object, according to the result of the sensing of the at least one image sensor **130**, and when the communication with the device associated with the object located in the second area is available, tracking the detected object, according to the result of the sensing of the at least one image sensor **130**, and location information of the object and user information which are received from the device associated with the detected object (**S930**, **S940** in FIG. 10).

[0142] According to an embodiment of the disclosure, the setting of the first area and the second area different from the

first area in the space in which the content is to be viewed (S210) may include sensing the space in which the content is to be viewed, based on a reproduction input for the content being received (S310, S410 in FIGS. 3 and 4). Also, the setting of the first area and the second area (S210) may include determining the first area and the second area, based on the space information according to the sensing and content information about the content for which the reproduction input is received (S320, S420 in FIGS. 3 and 4).

[0143] Also, the setting of the first area and the second area (S210) may include obtaining information about an allowed object that may be located in the second area (S330, S430 in FIGS. 3 and 4). Also, the setting of the first area and the second area (S210) may include transmitting information about the first area, information about the second area, and the obtained information about the allowed object to the server 200 that provides content (S340, S440 in FIGS. 3 and 4).

[0144] According to an embodiment of the disclosure, the setting of the first area and the second area different from the first area in the space in which the content is to be viewed (S210) may include, in response to receiving of a reproduction input for content having an execution history, receiving information about the first area and information about the second area from the server 200 that provides the content having the execution history (S510, S610 in FIGS. 6 and 7). Also, the setting of the first area and the second area (S210) may include determining the first area and the second area, based on the received information about the first area and the received information about the second area (S520, S620 in FIGS. 6 and 7).

[0145] According to an embodiment of the disclosure, the setting of the first area and the second area different from the first area in the space in which the content is to be viewed (S210) may include determining the first area and the second area, based on the space information and the content information about the content (S710, S810 in FIGS. 8 and 9). Also, the setting of the first area and the second area (S210) may include adjusting the first area and the second area, according to an input of a user of the virtual reality device 100 (S720, S820 in FIGS. 8 and 9).

[0146] According to an embodiment of the disclosure, a computer-readable recording medium having recorded thereon a program for executing the method may be provided.

[0147] According to an embodiment of the disclosure, the virtual reality device 100 is provided. The virtual reality device 100 may include the memory 110 storing one or more instructions, the processor 120, the at least one image sensor 130, the display engine 140, and the display 150. The processor 120 is configured to execute the one or more instructions to set a first area and a second area different from the first area in a space in which content is to be viewed, based on space information about the space in which the content is to be viewed and content information about the content. Also, the processor 120 is configured to execute the one or more instructions to sense the first area and the second area by using the at least one image sensor 130. Also, the processor 120 is configured to execute the one or more instructions to track an object located in the first area or the second area, based on a result of the sensing. Also, the processor 120 is configured to execute the one or more instructions to control a screen display of the virtual

reality device 100 by using the display engine 140 and the display 150, based on a result of the tracking.

[0148] According to an embodiment of the disclosure, the processor 120 may be configured to execute the one or more instructions to determine whether the object is located in the first area or the second area. Also, the processor 120 may be configured to display a screen of the virtual reality device 100 by controlling the display engine 140 and the display 150, according to a screen display mode based on a result of the determining.

[0149] Also, the processor 120 may be configured to execute the one or more instructions to, when the object is located in the second area, identify the object, and determine whether the identified object is an object pre-registered as an allowed object. The processor 120 may be configured to, based on a result of the determining, control the display engine 140 and the display 150 to display an indicator corresponding to the object on a content reproduction screen when the identified object is the pre-registered object, and display a see-through partial screen on the content reproduction screen when the identified object is not the pre-registered object. Also, the processor 120 may be configured to execute the one or more instructions to, when the object is located in the first area, control the display engine 140 and the display 150 to switch the content reproduction screen to a see-through full screen.

[0150] Also, the processor 120 may be configured to execute the one or more instructions to determine a location of the indicator or the see-through partial screen on the content reproduction screen, based on at least one of a location, a movement direction, or a movement speed of the identified object.

[0151] According to an embodiment of the disclosure, the virtual reality device 100 may further include the communication interface 170. Also, the processor 120 may be configured to execute the one or more instructions to detect the object, and determine whether communication with a device associated with the object located in the second area is available. The processor 120 may be configured to, based on a result of the determining, when the communication with the device associated with the object located in the second area is not available, track the detected object, according to the result of the sensing, and when the communication is available, track the detected object, according to the result of the sensing, and location information of the object and user information which are received via the communication interface 170 from the device associated with the detected object.

[0152] According to an embodiment of the disclosure, the virtual reality device 100 may further include the input device 180. Also, the processor 120 may be configured to execute the one or more instructions to sense, by using the at least one image sensor 130, the space in which the content is to be viewed, based on a reproduction input for the content being received via the input device 180. The processor 120 may be configured to determine the first area and the second area, based on the space information according to the sensing and content information about the content for which the reproduction input is received.

[0153] Also, the virtual reality device 100 may further include the communication interface 170. Also, the processor 120 may be configured to execute the one or more instructions to obtain, via the input device 180, information about an allowed object that may be located in the second

area. The processor **120** may be configured to transmit, via the communication interface **170**, information about the first area, information about the second area, and the obtained information about the allowed object to the server **200** that provides content.

[0154] According to an embodiment of the disclosure, the virtual reality device **100** may further include the communication interface **170** and the input device **180**. In response to receiving, via the input device **180**, a reproduction input for content having an execution history, the processor **120** may be configured to execute the one or more instructions to receive, via the communication interface **170**, information about the first area and information about the second area from the server **200** that provides the content having the execution history. The processor **120** may be configured to determine the first area and the second area, based on the received information about the first area and the received information about the second area.

[0155] According to an embodiment of the disclosure, the virtual reality device **100** may further include the input device **180**. The processor **120** may be configured to execute the one or more instructions to determine the first area and the second area, based on the space information and the content information about the content, and may adjust the first area and the second area, according to an input of the user of the virtual reality device **100** via the input device **180**.

[0156] According to an embodiment of the disclosure, the processor **120** may be configured to execute the one or more instructions to differently set an area range of the first area, according to a type of the content included in the content information.

[0157] A person of ordinary skill in the art would understand that the descriptions of the disclosure are exemplary and the disclosure may be easily embodied in many different forms without changing the technical concept or essential features of the disclosure. Thus, it should be understood that the embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. For example, configuring elements that are singular forms may be executed in a distributed fashion, and also, configuring elements that are distributed may be combined and then executed.

[0158] At least one of the components, elements, modules and units (collectively “components” in this paragraph) represented by a block or an equivalent indication in the drawings as described above may use a direct circuit structure, such as a memory, a processor, a logic circuit, a look-up table, etc. that may execute the respective functions through controls of one or more microprocessors or other control apparatuses. Alternatively or additionally, at least one of these components may be specifically embodied by a module, a program, or a part of code, and contains one or more executable instructions for performing the above-described functions, and executed by one or more microprocessors or other controller. Further, at least one of these components may include or may be implemented by a processor such as a central processing unit (CPU), graphic processing unit (GPU), another type of microprocessor, or the like to perform the above-described functions. Two or more of these components may be combined into one single component which performs all operations or functions of the combined two or more components. Also, at least part of functions of at least one of these components may be performed by

another of these components. Functional aspects of the above example embodiments may be implemented in algorithms that execute on one or more processors.

[0159] The scope of the disclosure is defined by the appended claims, rather than the detailed description, and all differences and modifications that can be derived from the meanings and scope of the claims and other equivalent embodiments therefrom will be construed as being included in the disclosure.

What is claimed is:

1. A method of controlling a virtual reality device, the method comprising:

based on space information obtained by scanning a space in which content is to be viewed by using the virtual reality device and content information about the content, setting a first area and a second area different from the first area in the space;

sensing the first area and the second area by using at least one image sensor, while the content is being reproduced;

tracking an object located in the first area or the second area, based on a result of the sensing; and

controlling a display of a screen of the virtual reality device, based on a result of the tracking.

2. The method of claim 1, wherein the controlling the display of the screen comprises:

determining whether the object is located in the first area or the second area; and

displaying the screen of the virtual reality device, according to a screen display mode based on a result of the determining.

3. The method of claim 2, wherein the displaying the screen of the virtual reality device comprises:

based on the object being located in the first area, switching a content reproduction screen to a see-through full screen, and

based on determining that the object is located in the second area:

identifying the object, and determining whether the identified object is pre-registered as an allowed object to be present in the second area;

based on a result of determining that the identified object is pre-registered as the allowed object, displaying an indicator corresponding to the object on the content reproduction screen; and

based on a result of determining that the identified object is not pre-registered as the allowed object, displaying a see-through partial screen on the content reproduction screen.

4. The method of claim 3, wherein at least one of a location of the indicator or the see-through partial screen on the content reproduction screen may be determined based on at least one of a location, a movement direction, or a movement speed of the identified object.

5. The method of claim 1, wherein the tracking the object comprises:

detecting the object;

determining whether a communication with a device associated with the object located in the second area is available; and

based on a result of determining that the communication is not available, tracking the detected object based on the result of the sensing; and

based on a result of determining that the communication is available, tracking the detected object based on the result of the sensing, and further based on a location information of the object and a user information which are received from the device associated with the detected object.

6. The method of claim 1, wherein the setting comprises: sensing the space in which the content is to be viewed, based on a reproduction input for the content being received; and determining the first area and the second area, based on the space information based on the result of sensing the space and the content information about the content.

7. The method of claim 1, wherein the setting further comprises: obtaining information about an allowed object that is allowed to be present in the second area; and transmitting information about the first area, information about the second area, and the obtained information about the allowed object to a server that provides the content.

8. The method of claim 1, wherein the setting further comprises: in response to receiving a reproduction input for content having an execution history, receiving information about the first area and information about the second area from a server that provides the content having the execution history; and determining the first area and the second area, based on the received information about the first area and the received information about the second area.

9. The method of claim 1, wherein the setting further comprises: determining the first area and the second area, based on the space information and the content information about the content; and adjusting the first area and the second area, according to an input of a user of the virtual reality device.

10. A computer-readable recording medium having recorded thereon a program for executing the method of claim 1.

11. A virtual reality device comprising: at least one memory configured to store one or more instructions; at least one processor; at least one image sensor; a display engine; and a display, wherein the at least one processor is configured to execute the one or more instructions to: based on space information obtained by scanning a space in which content is to be viewed and content information about the content, set a first area and a second area different from the first area in the space; sense the first area and the second area by using the at least one image sensor, while the content is being reproduced; track an object located in the first area or the second area based on a result of the sensing; and

control a display of a screen of the virtual reality device by using the display engine and the display, based on a result of the tracking.

12. The virtual reality device of claim 11, wherein the at least one processor is further configured to execute the one or more instructions to:

determine whether the object is located in the first area or the second area; and

display the screen of the virtual reality device by controlling the display engine and the display, according to a screen display mode based on a result of the determining.

13. The virtual reality device of claim 11, wherein the at least one processor is further configured to execute the one or more instructions to:

based on the object being located in the first area, switching a content reproduction screen to a see-through full screen, and

based on the object being located in the second area:

identify the object, and determine whether the identified object is pre-registered as an allowed object to be present in the second area;

based on a result of determining that the identified object is pre-registered as the allowed object, control the display engine and the display to display an indicator corresponding to the object on the content reproduction screen; and

based on a result of determining that the identified object is not pre-registered as the allowed object, control the display engine and the display to display a see-through partial screen on the content reproduction screen.

14. The virtual reality device of claim 11, further comprising a communication interface,

wherein the at least one processor is configured to execute the one or more instructions to:

detect the object;

determine whether a communication with a device associated with the object located in the second area is available;

based on determining that the communication being not available, track the detected object, based on the result of the sensing; and

based on determining that the communication being available, track the detected object, based on the result of the sensing, and further based on location information of the object and user information which are received via the communication interface from the device associated with the detected object.

15. The virtual reality device of claim 11, further comprising an input device,

wherein the at least one processor is configured to execute the one or more instructions to:

obtain a result of sensing, by using the at least one image sensor, the space in which the content is to be viewed, based on a reproduction input for the content being received via the input device; and

determine the first area and the second area, based on the space information according to the result of sensing and the content information about the content.

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